The Welding Engineer

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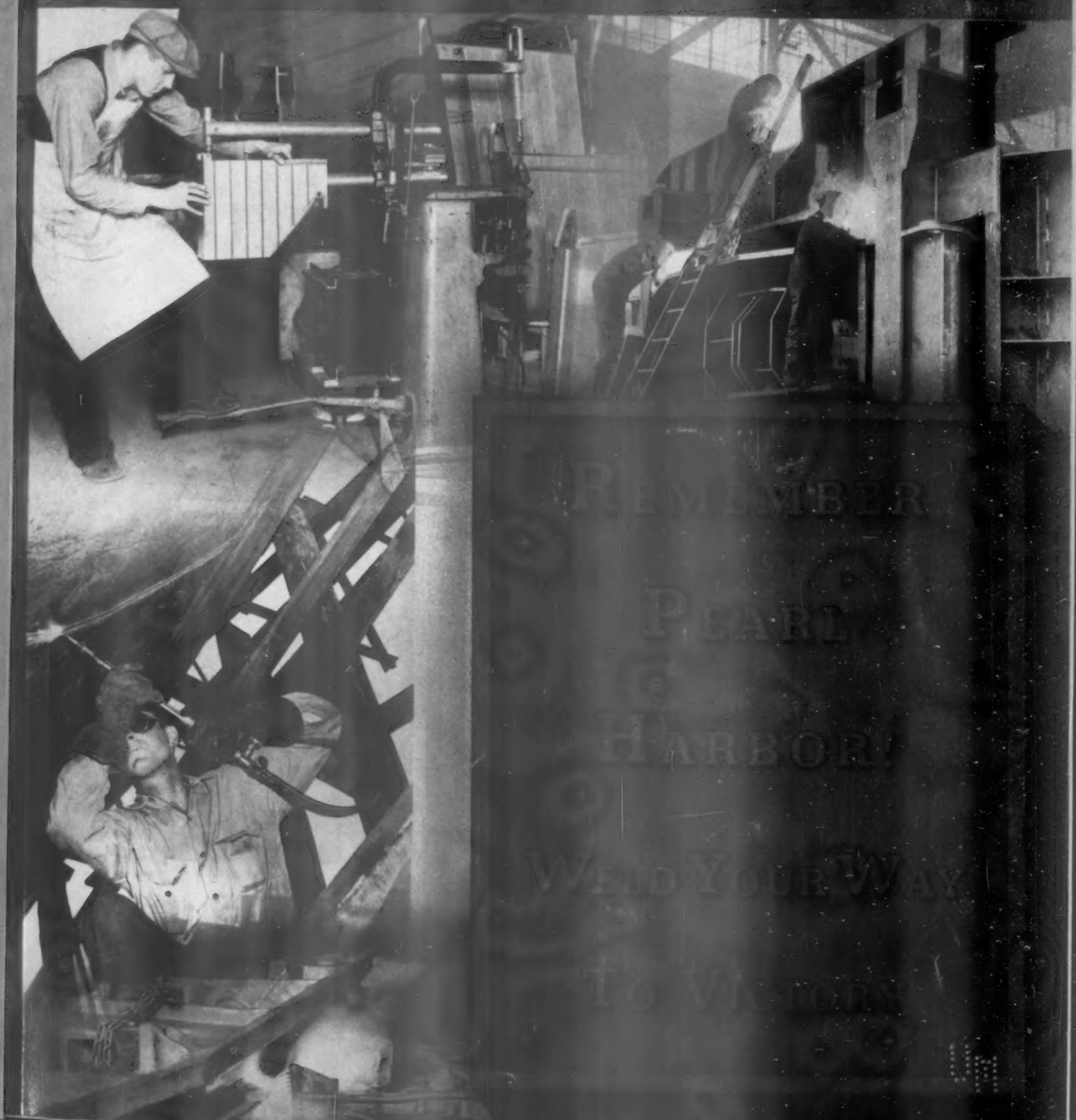

REMEMBER

PEARL

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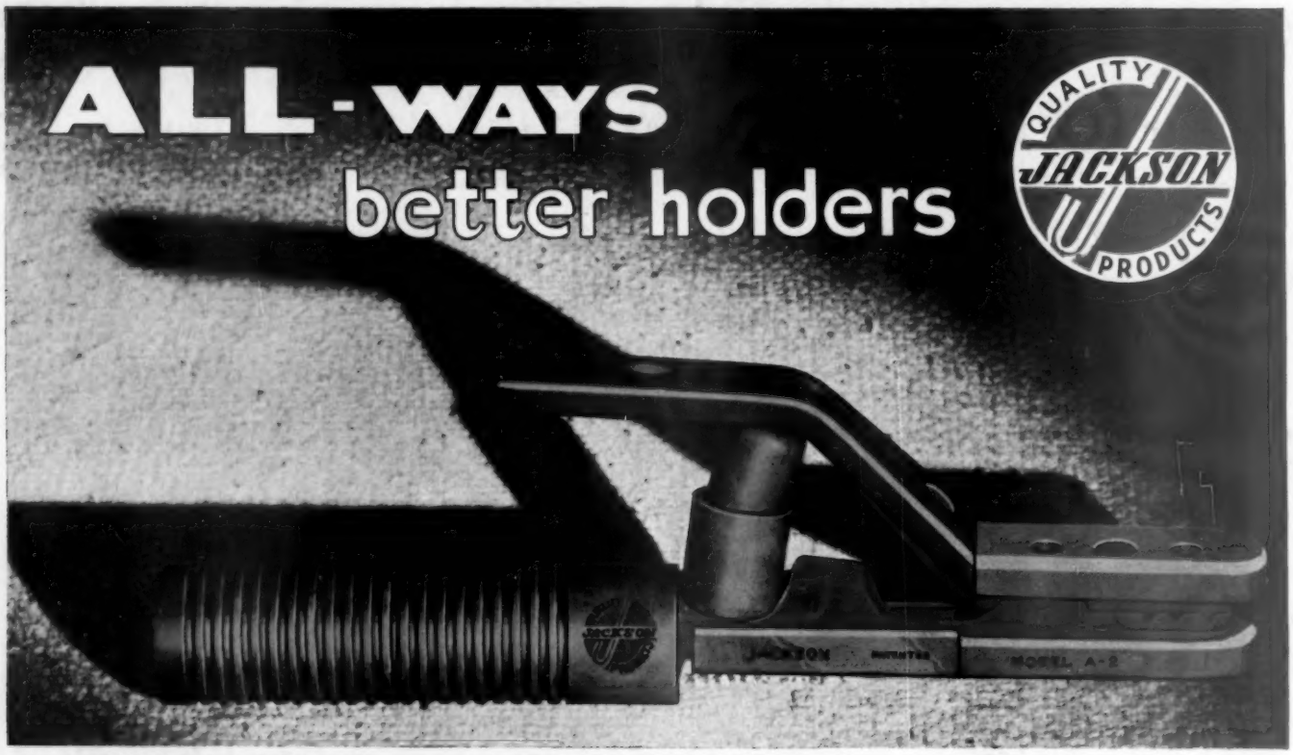
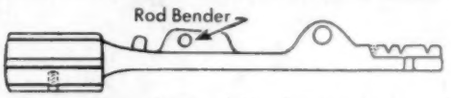
WELD YOUR WAY

TO VICTORY



Model A-2 (above) with new rod bender. Fully insulated, scientifically ventilated, it's a 300 Amp. job taking rods from 1/16" to ¼". Replaceable jaws of Mallory 3 Metal. Mechanical cable connection (soldered if you wish) is thoroughly dependable.



Lower tong (part #6) showing new rod bender.

JACKSON holders are better because in ALL-WAYS they embody up-to-the-minute, field tested improvements in design. Our new rod bender, illustrated here, now made part of the lower tong of all Jackson A and B models except B-4 and B-5, is a typical example. Welders accustomed to bending rod before using will find this an unusual and convenient feature.

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G. H. MACKENZIE
President and Treasurer

T. B. JEFFERSON
Editor

FRANK RICHTER
Promotion Manager

» «

Eastern Representative:
T. E. DEPEW, 1834 Broadway, New York, N.Y.
Tel. Columbus 5-7843

Midwest Representative:
D. R. WATSON, 506 S. Wabash Ave.
Chicago: Tel. Webster 7134

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W. R. McINTYRE, 400 East Third St.
Los Angeles, Tel. Michigan 8918

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Our Mutual Task

THERE can be no better time than this beginning of 1942 to thank our customers for their unfailing patience and the consideration they have shown in the past twelve months toward our efforts to supply the myriad emergency demands for steel.

Today you as consumers and we as producers of steel have a mutual task of achieving the maximum output of materials for war. We must also produce materials for the indispensable minimum of goods for our domestic economy.

The coming of active warfare has made our mutual task as the year opens increasingly arduous. Bethlehem is exerting the utmost effort to meet unprecedented demands. It is our purpose to serve our Government to the utmost of our ability in this emergency. More than 800,000 tons of steel capacity has already been added, together with accompanying increase in coke ovens and blast furnaces, and expansion of finishing facilities. Further expansions in ingot capacity, and in rolling mills, forges and shops, are anticipated. We are purchasing a wide variety of materials from more than 10,000 suppliers. Our employment rolls have been stepped up to more than 180,000.

With all of this, the demand for our products continues unabated, and 1942 will continue to require the full cooperation and understanding between steel maker and steel user.

It is a gratifying and typical characteristic of American industry that all the needs of our Government and of our national purpose have been met on all sides during the past year with vigor and cheerfulness.

Now is added a still greater and unremitting determination. We know that there will be the whole-hearted cooperation of all, so that what needs be done, shall be done.

"Enough, if something from our hands have power,
To live, and act, and serve the future hour."

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

Engineering

★ PROGRESS

The Army's field welding shop.

U. S. Army Quartermaster Corps Photo

1941—

A Banner Welding Year

T. B. JEFFERSON, Editor

Welding gains surpassed all expectations in 1941. New uses, new developments and new equipment marked the Welding Industry's contribution to America's war program. Without welding our country's armament program would be impossible.

War, as distasteful as it is to all of us, did much for the welding industry in 1941. It was our defense demands which first called for production increases and then with lend-lease and wartime production industries were forced to seek not only the best but the fastest and most economical means of fabrication. Welding, of course, was its only answer.

With America's industrial effort converted from peacetime to wartime production on the greatest scale ever known to man, it was only natural that such production should cause many changes in fabrication processes. Many experienced users of welding were introduced to unfamiliar types of work while other plants were introduced to the advantages of welding for the first time.

The fact that many plants, for the first time, have been introduced to the advantages of the welding and cutting processes will probably be 1941's outstanding contribution to the welding industry. These new users of welding and flame-cutting and treating processes have discovered the production possibilities and advantages made possible by these superior fabricating processes. As a result of these discoveries welding and cutting has been established as a part of each new user's production procedure and will permanently displace previous joining and cutting methods.

The casualties from ricocheting rivet heads in military tanks and war ships, following explosive hits, and the fact that armor plate can be welded successfully, lead the Army and Navy officials to use welding more extensively in the construction of military tanks, ships, gun carriages, gun mounts and numerous other armament items.

The Maritime Commission readily recognized that our hopes for a quick merchant marine lay in the speed and economy made possible by the prudent use of welding and cutting. This knowledge alone led to the establishment of several new shipyards during 1941 equipped only for the construction of welded ships from flame-cut plates.

This widespread acceptance of welding by our government officials has placed welding much in the news. It was seldom during the year that one visited a theater and saw a newsreel that did not picture some welding or cutting operations. These actual views of the workings of the welding industry coupled with news releases and magazine articles, taught the public during 1941 that welding offered a process of fabrication and maintenance of importance to our National Safety rather than a related repair tool of the nearby garage or something that was occasionally done to street car rails.

Even though the acceptance of welding throughout industry was general and the public readily accepted the claim for its possibilities, all was not rosy for the welding industry. Priorities were one of the industries' stumbling blocks.

Early in 1941 the Office of Production Management recognized the need for electric arc and resistance welding machines and issued a blanket priority order to cover materials required to produce this equipment. Later a blanket order was issued to cover materials required for the production of resistance welding electrodes and finally, as the year drew to a close, a third order which provided a means for job shops to obtain replacement parts, was issued. While all of these grants were helpful it would seem that the OPM is either

short sighted in its plans or has failed to ascertain the importance of the manufacture of gas welding and cutting equipment to the building of armament. One who is familiar with the steel industry would have difficulty visualizing a steel mill in operation without gas regulators or cutting torches. Likewise, it is difficult to conceive how a shipyard could operate without these devices. Then, too, what single item is more essential in the salvaging of a damaged naval craft than a cutting torch; a cutting torch which can quickly cut steel plates under water as well as in the open air!

The manufacturers of all types of welding equipment enjoyed a seller's market during 1941. In all phases of the industry the backlog of orders are believed to be equal to the total orders for 1941. The production of welding wire for the year will undoubtedly reach the unexpected total of 445,000,000 lbs. Of this total it is estimated that 375,000,000 lbs. will be made into electrodes. These figures very nearly double the 1940 figures for welding wire and electrode production.

Highlights of the outstanding accomplishments of the various phases of the welding industry will be found in the columns which follow:

Electric Welding

The increase in the use of arc welding during 1941 was quite pronounced. While the process was well established before we undertook our defense program, it was greatly accelerated by our war effort in an endeavor to obtain greater production speed and at the same time conserve materials.

Probably the outstanding development during 1941 in the arc welding field was the successful use of austenitic stainless steel electrodes for the welding of armor. As a result, this type of electrode has become indispensable in the Army tank building program. Incidentally, the use of stainless steel electrodes despite the fact that they have been eliminated from the "non-essential" industries, have increased more than ten times during the past year. This increase can be attributed directly to the important role that stainless steel electrodes are making in our armament program. It has been predicted by ordnance officers that the entire military tank industry will soon shift to arc welded armor.

1941 found many advances in arc welding in the ship construction field. The Navy specified arc welding to be used in the construction of experimental blockade running cargo ships. The Sea Otter was the first of this type. Here again arc welding made it possible to construct a ship quickly, economically and also one that was quite resistant to shocks.

One of the major surprises in the arc welding field was the switch from gas welding to arc welding in aircraft construction. Until this year practically all aircraft, particularly in military aircraft all tubular structures were gas welded. The current trend has changed to arc welding and it is estimated now that at least 60% of these aircraft tubular structures are of arc welded construction.

Ingenuity also entered into the arc welding field in that many manufacturers were called upon to redesign equipment because of material shortages. An outstanding example of this was found where a manufacturer was required to re-design a piece of Government equipment substituting welded steel for a combination of wood and aluminum. Everyone was surprised to learn that the new design, a design in which light weight was important, weighed even less when made of welded steel than it did as a wood and aluminum composite structure.

All the developments, however, were not confined to the design field. During the year there were introduced, several new types of welders designed for specific jobs. Of particular interest was the advances made in the use of A-C welding where marked increases in speed and economy are achieved. The developments here, aside from the direct welding benefits, were reflected in a remarkable saving of power that was made possible through power factor correction features of this type of equipment. Naturally, in a country faced with a power shortage this was important for it released power for other needed purposes.

All in all, during 1941 arc welding proved to be a very effective process for aiding our country in its race against time and destruction. It is arc welding coupled with its inseparable companion, flame cutting, that has made it possible for this country, in a short space of a year, to provide powerful war machinery for the democracies of the world.

Gas Welding

The gas welding industry was confronted with many demands during 1941. Those in the industry found that it was necessary to adapt or develop processes for new or special applications with emphasis on the expediting of production. It was also necessary for them to provide assistance to the users of their equipment so that those engaged in America's industrial effort would enjoy full realization of the potentialities offered by the gas welding and cutting processes. The job was well done! Today we find that the flame processes are indispensable to our armament industry requirements.

Particularly in the shipbuilding industry has the flame cutting and treating processes been found indispensable. To cope with the problems encountered in this field there was developed during the year a new cutting equipment using divergent nozzle cutting tips. With these new tips it is said it is possible to reduce cutting oxygen consumption from 25 to 40% as compared with that required of the ordinary cutting tip. In addition, it is possible to operate at speeds of 20 to 25% greater than those obtained with ordinary cutting tips when using the same oxygen discharge rate. These noteworthy gains result from the narrow velocity cutting stream and consequently narrow kerf. The latter is said to be 30 to 50% narrower than when ordinary tips are employed. Such an item is naturally important to industry as it accomplishes those aims everyone is striving to attain; it conserves material and increases speed.

Flame descaling and flame priming also proved of importance in the armament industries. Flame descaling is particularly helpful in removing the scales from castings and rolled or forged shapes and plates, including armor plate in certain stages. This descaling method has been found to be completely effective and an aid to subsequent machining. The chief advantage gained from this application is that it is rapid and requires very little floor space for the equipment. Likewise, none of the scale is peened into the metal.

Flame priming was found useful in removing rust and scale and con-

Libia proved that American tanks should be welded.

Official British Photo from OPM

Ingalls Shipbuilding Corp. Photo

The world's largest welded passenger ship was built in 1941.

sequently leaving a warm dry surface for the application of paint. Flame priming proved effective in that it gives the paint a low temperature bake on a hydrated surface which is said to prolong the life of paint appreciably. This process offers many advantages, first, the cleaning and painting operations are performed right on the job. Secondly, work can proceed on a 24-hour a day basis because the structures are made warm and dry without sunshine.

Naturally, in the machine cutting field many developments were introduced. Special installations were devised to fit the various types of plate handling equipment for the rapid preparation of edges to the required tolerances that are necessary in the cutting of plates for welding in ship construction, the cutting of armor plates, the cutting of billets and the shape-cutting of many parts for both new and maintenance work.

Billet cutting was of particular importance. The flame cutting of billets, blooms, slabs and ingots either hot or cold, has been going on for years. But today's acute demands for high production cut off equipment led to the development of new principles in these machines. Of particular importance was the use of this equipment in the cutting of shell forging slugs and for the nicking of billets in our "billets to bullets" campaign.

1941 also saw the development of air and water cooled torches for use in the many operations in the armament industry where excessive heat would otherwise seriously hamper torch operations. Regulators have been improved so that they are capable of maintaining an amazing degree of pressure accuracy over the entire range of diminishing cylinder pressure.

The flame processes have proved themselves indispensable to America's urgent industrial requirements. The oxy-acetylene flame, together with the scientific research attendant to its employment, will share a big part in the industrial achievement that will utimately assure victory for our country in this national conflagration.

Resistance Welding

THE past year had been one of progress in the working out of techniques for resistance welding of many metals and alloys which heretofore had been considered extremely difficult or impossible so far as welding was concerned. This development was primarily in connection with the aircraft industry.

Engineers and manufacturers in the aircraft industry realized that much could be done to speed production. For this reason they had been endeavoring to change the construction of airplane parts so that they could be welded instead of riveted. In this respect many of the manufacturers of resistance welding equipment were able to step in and give assistance in the designing of fixtures, jigs and machines which greatly expedited the work of building aircraft and other defense items. It was only natural that these manufacturers' past experience in sheet metal fabricating industries such as are found in the manufacture of automobiles, washing machines and refrigerators, would have a wide variety of experience that would be extremely valuable in the aircraft field.

The stored energy type of spot welder was developed further and has received wide acceptance by the aircraft industry and the Government for the joining of aluminum and its alloys.

The refrigerated cooling of electrode tips in connection with the spot welding of aluminum, was introduced for the first time in 1941. There was further expansion in the use of pulsation welding for the welding of heavy steel sections and it has been predicted that this type of welding will probably replace rivets in those "have to be riveted" phases of ship construction.

The educational activities in the resistance welding field were particularly important during the past year. Some very commendable work was performed by the several committees doing research and standardization work especially in connection with the welding of aluminum and aluminum alloys, problems which are so vital to our war program. Much has been done to show that by the use of well designed resistance welding equipment, correctly selected alloys and proper control will result in greater production and stronger welds at a very low cost.

Thermit Welding

The maintenance and reclamation of heavy equipment, particularly of the type found in railroad shops, steel mills and armament industries continue to increase the demand for Thermit welding. This process made new gains, however, and is rapidly becoming recognized as a process of welding for production as well as for maintenance. Thermit welding has been found particularly advantageous in production which involves the fabrication of heavy steel sections, either cast iron or rolled, and heavy cast iron sections.

The principal production use of Thermit during 1941 was for the fabrication of stern posts for ships being constructed for the Maritime Commission. To meet the "ship-a-day" demand for our merchant marine, it has been found that it is speedier and less costly to cast stern post frames in a number of small pieces rather than the large single piece as has been the custom. In this manner small foundries can be given the work of making the multi-piece stern post frame leaving larger and more complicated work for the foundries that are capable of handling the larger castings. The many castings that are needed for a stern post frame are then assembled and joined by Thermit welding — resulting in faster production.

Probably the outstanding accomplishment in the field of Thermit welding appeared in the form of the world's largest freight car. In this case heavy "H" beams which formed the car were joined by Thermit welding. The five separate members making up each beam were butt welded by this process.

Lincoln Electric Co. Photo

South African postage stamps popularize welding.

As Some of the Industry's Leaders Say . . .

"The current, stepped-up program in American industry has stimulated the use of oxy-acetylene machine-cutting for many types of work. Chief among these is the preparation of plate for welding in ship construction, the cutting of armor plate, the cutting of billets, and shape-cutting of many types of parts."—*R. S. BABCOCK, Linde Air Products Co.*

» «

"Not least in importance is the problem of the welding of armor plate. Confining ourselves to the resistance welding of this material, we predict that a successful and satisfactory welding technique in method will soon be announced for the spot welding of the lighter gauges of armor plate."—*L. M. BENKERT, Progressive Welder Co.*

» «

"A most outstanding development has been the very rapid increase in the consumption of stainless steel electrodes for various Navy and tank welding applications. From all indications a further increase is indicated in this line for the coming year."—*W. H. BLEECKER, Page Steel & Wire Div., American Chain & Cable Co., Inc.*

» «

"Undoubtedly the confidence with which the United States Army and Navy are using stainless steel electrodes for welding air hardening steels is one of the outstanding accomplishments of the welding industry for the year 1941."—*E. J. BRADY, Alloy Rods Co.*

» «

"Necessity may be the 'mother of invention'—but, in the case of arc welding, emergency has certainly been the 'daddy of acceptance.' The full extent to which arc welding has contributed to more effective use of the available supplies of critical materials will probably never be known."—*W. J. CHAFFEE, The Hobart Brothers Co.*

» «

"Obviously, with the tremendous increase in machine gas cutting, due to our war efforts, the advent of these divergent nozzle cutting tips, just at this time is most opportune. They will prove a great aid in speeding up the work and increasing production economically."—*E. V. DAVID, Air Reduction Sales Co.*

» «

"The use of arc welding, already well established before the defense effort, has been accelerated by the need for greater speed, increased economy of materials and greater resistance to shock. Many contracts issued by the Army and Navy have specified the use of arc welded steel, where other methods of construction previously had been used."—*A. F. DAVIS, Lincoln Electric Co.*

» «

"Flame descaling and flame priming are taking an important part in our National Defense program. Flame descaling is particularly helpful in removing scale from castings, shapes and plates, including armor in certain stages. Flame priming is speeding the painting of defense buildings."—*E. W. DECK, Linde Air Products Co.*

» «

"Employment of arc and resistance welding through careful selection of assemblies or redesign of same have saved considerable man-hours. But both from standpoint of savings in time and application, the ultimate usefulness of these production tools has not been reached."—*C. J. GALLANT, North American Aviation, Inc.*

» «

"Developments have vastly increased the degree of reliability which can now be placed in spot welding, which will, undoubtedly, vastly increase its use, thereby increasing aircraft production and reducing aircraft cost."—*S. M. HUMPHREY, Taylor-Winfield Corp.*

"Many industrial leaders have recognized the fact that resistance welding is one of the fastest and most economical methods of metal fabrication."—*R. T. GILLETTE, General Electric Co.*

» «

"Oxy-acetylene welding continues to play an increasingly important part in industry, both as a rapid, economical fabricating procedure and as an indispensable method for the maintenance and repair of equipment."—*H. V. INSKEEP, Linde Air Products Co.*

» «

"The past year has witnessed a remarkable growth in the output of welding materials and equipment and in the fabrication of National Defense welded products."—*COL. G. F. JENKS, American Welding Society.*

» «

"The value of arc welding as a production tool or process for the manufacture of ships, tanks, machine tools and practically all equipment needed for mechanized warfare is reflected by a demand for arc welding machines and electrodes never before equaled."—*C. I. MACGUFFIE, General Electric Co.*

» «

"Armament industries, where excessive heat would otherwise seriously hamper torch operations, are meeting production schedules by using fully water cooled or air cooled torches or a combination of both. Torch applications of this type are particularly important in ordnance and aircraft welding where confined spaces deflect heat and cause overheating."—*E. L. MATHY, Victor Equipment Co.*

» «

"The increase in the use of all methods of welding and welding equipment used in the fabrication of airplanes and airplane parts will play a major role in assisting the aircraft industry to meet the demands of the United States Government in that part of the war program, and will enable industry to produce such products on a sound economical basis."—*J. W. MEADOWCROFT, Edward G. Budd Mfg. Co.*

» «

"With the transition from civilian production to National Defense Production and with the great increase of welding of aluminum and stainless steel more particularly, I feel that industry as a whole has become better welding minded."—*G. N. SIEGER, S-M-S Corp.*

» «

"Our security is linked to ever-increasing defense production. Without the oxy-acetylene flame, metal fabrication could never be expanded in synchronism with the needs of defense production."—*G. V. SLOTTMAN, Air Reduction Sales Co.*

» «

"The most significant thing that has happened in the past twelve months in the industry is the tremendous stepping up in the production of welding electrodes. The output has been more than doubled in this short space of time."—*MERRITT L. SMITH, Metal & Thermit Corp.*

» «

"The inherent advantages of oxy-acetylene flame-hardening, for imparting a hard, wear resistant surface to quench-hardenable steels, have resulted in the adoption of the process for a number of new applications. For example; parts for automotive equipment, sprocket teeth, the raceways of turret rings, grousers, and armor plate and automatic rifle parts."—*P. E. TIMMERMAN, Linde Air Products Co.*

» «

"1941 is another milestone in the resistance welding industry because during this year resistance welding was really pegged as a precision method of assembly."—*J. A. WEIGER, P. R. Mallory & Co., Inc.*

★ MAINTENANCE

Rebuilding 11 to 14% Manganese Steel *Crusher Plates*

Fig. 1—A group of manganese steel crusher plates—some worn—some reclaimed.

Material shortages are making proper equipment essential. In rebuilding manganese steel crusher plates warping must be controlled. Two methods of warpage control are described.

By **R. B. LEWIS**
District Sales Manager
Stulz-Sickles Co.

OPERATORS of jaw crusher equipment, that is, operators of mines, quarries, sand and gravel plants and similar industries, are vitally interested in rebuilding their jaw crusher plates. Not only is it good business to keep crusher jaws in good repair, for it is known that as the corrugations wear down the efficiency of the plant operation decreases, but because of the shortage of metals and fabricating facilities due to our increased war effort it is patriotic to conserve.

Warpage Controlled

The major difficulty to be overcome in repairing jaw crusher plates is warpage. There are two methods by which warpage may be controlled. The first involves the replacement of the metal lost through wear by welding in filler bars. By this procedure the metal which has been worn away is replaced by welding in round manganese-nickel applicator or filler bars instead of using welding alone to replace the lost metal. As shown in Fig. 2 when reclaiming jaw crusher plates, these filler bars are placed on top of the worn corrugations. Full length bars are not used but rather several short pieces. A small space is left between the ends of the abutting bars so that they can be welded together after the bars have been welded lengthwise to the plate. By leaving this space between the bars, allowance is made for expansion or contraction which takes place during the welding of them to the plate.

Now that the bars have been placed and properly spaced on the crusher plate, they are ready for tack welding. Here again to allow for contraction on cooling of the weld there should be provided a small space between this bar and the plate. It has been found that the best results have been obtained when the bar is raised from $\frac{1}{16}$ to $\frac{1}{8}$ in. off the plate (Fig. 3). This opening can be obtained by resting the bar on a straw or a paper match before beginning the tack welding operation.

Short Bar Method

The following procedure is recommended for use in welding the short bars to the crusher plates. Referring again to Fig. 2, the bars should be welded as indicated. Deposit a full length electrode on one side of the bar, then after peening, deposit an-

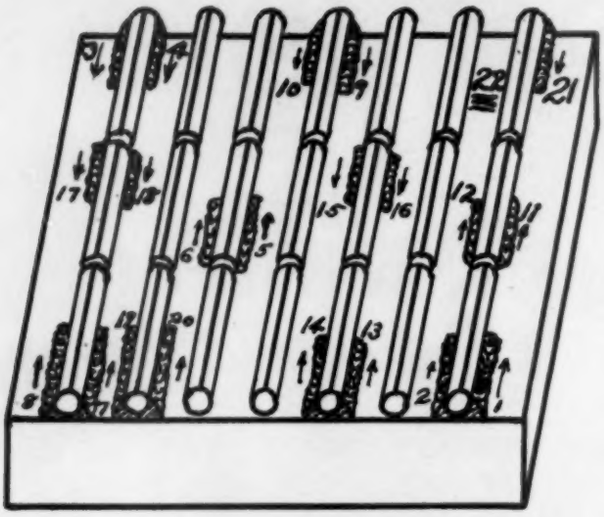


Fig. 2—In one method of reclaiming crusher plates, short filler bars are welded to the worn corrugations.

other full length electrode on the opposite side of the bar in the same direction. Care should be taken to always weld in the same direction on a particular bar. When one bar has been welded in this manner, skip to another part of the plate and go through the same procedure. After all of the bars have been attached with one full length electrode on each side, then repeat the procedure depositing the second electrode on each side of each bar, then the third, etc.

Peening Important

Probably the most important part of this job is the peening of both the deposited metal and the filler or applicator bar while they are hot. This peening action compensates for the contraction of the metal on cooling.

Bent Plate Method

A second method which may be used to overcome warpage is to weld on both the front and the back of the plate. In this method the crusher plate is first warped by welding on the back side, then pulled straight by welding on the front surface. This may be accomplished very simply.

Lean the plate against the wall at a sharp angle so that the corrugations face the wall and run parallel to the floor. On the back of the crusher plate it will be noted that to lighten casting there are many hollow spaces which are separated only by thin webs. So as to make it an easy matter to "bow" the casting somewhat, it is necessary to cut those webs which run parallel to the corrugations on the crushing surface. Using either an oxy-acetylene torch or the electric arc with the latter the preferred method, a cut ⅜ to ¾ in. wide depending on the size of the plate, should be made through the horizontal web (Fig. 4) right through to the bottom of the hollow.

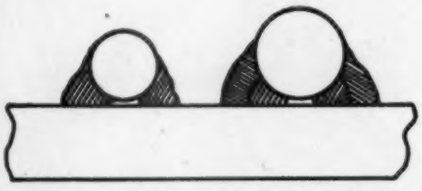


Fig. 3—One or two beads form the weld fillet depending on the size of the filler bar. Note the space between bar and plate.

After all of the webs have been cut, the plate should be placed on its face flat on the floor or bench while used metal is deposited in the bottom of these hollows. For this operation a large size electrode and high amperage is recommended. This manner of welding allows the plate to get very hot so that in cooling there will be considerable shrinkage. It is not necessary to fill the entire space; usually the running of a few beads in the bottom of the hollow parallel to the corrugations will be sufficient. This deposit should not be peened for its purpose is to curve the plate, a condition that will be noted as welding progresses and the plate cools. This curving procedure can be accomplished very quickly even on the larger crusher plates.

After the plate has been cooled and only then, should welding be started on the front side. In the warped plate method a single applicator bar may be placed the full length of the worn corrugations instead of in short lengths as previously outlined. With the plate again placed against a wall at a sharp angle, welding is commenced. (Fig. 5), and the bars are tack welded in place.

The welding should then be completed as quickly as possible. In this application each bar is welded throughout its length with beads deposited on each side before proceeding to the next bar.

When one is confronted with two alternatives as a means of accomplishing a particular job, the question is often asked "What determines which method should be used?"

Which to Use

In the case of rebuilding crusher plates, the method to be used is the one which will cause the least warpage. It should be remembered that it is not so much the heat that gets into the plate that causes the warpage as it is the contraction of the weld metal deposited. It should be kept in mind that the more welding that is required to apply an applicator bar, the greater is the allowance which must be for warpage. Experience will show that every job is different. If the crusher plate is a large, thick one, but not badly worn, the short bar method is the one to select. If the plate is of the same size, however, and the corrugations are badly worn, combine the short bar and warped plate methods. On a small plate, not badly worn, use either the first or the second method, whichever is the most convenient but, if the plate is badly worn, combine the best features of the two methods.

It has been found that when welding applicator bars to crusher plates

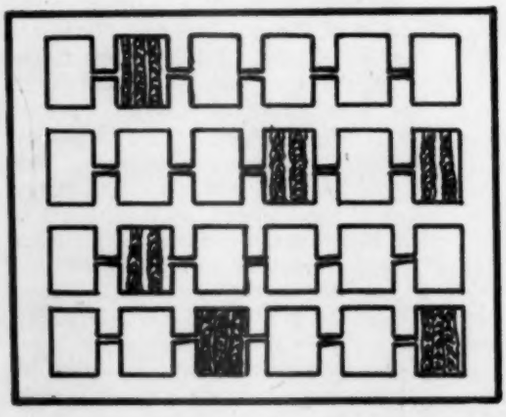


Fig. 4—A crusher plate may be warped deliberately by welding in the pockets on the under side.

the best results are obtained by using 3½% manganese-nickel bare electrodes throughout the entire procedure. With bars of ¾ in. dia. or smaller, it is recommended that a full fillet deposit be made (See Fig. 3). In this manner sufficient metal is deposited in the first pass to eliminate the necessity of depositing a second bead. When the bar is larger than ¾ in. dia., two passes are used, the first with a $\frac{5}{16}$ in. electrode and the finishing pass with a ¼ in. electrode.

If the rebuilding is accomplished by the use of short applicator bars as described in the first method of reclamation and the bars are larger than ¾ in. dia., deposit a $\frac{5}{16}$ in. electrode on both sides of the bar, then finish the fillet with a ¼ in. electrode before starting to weld the next short length of bar.

It should be kept in mind that plenty of peening of both deposited metal and applicator bar is necessary, using either the hand or pneumatic hammer. Do not allow the plate to get too hot and skip from place to place in order to evenly distribute the heat. It is the writer's experience that when these bars are properly attached, the job will prove entirely satisfactory when completed and placed in service. When using either procedure described it is not unusual for quarries to rebuild the same crusher plates several times before discarding them. Each such repair not only represents a reduction in maintenance expense but oftime results in the repaired plate becoming superior to new ones.

Fig. 5—Placing the crusher plate against the wall at a sharp angle affords a better opportunity to control warpage during welding.

At these plants, jaw crusher plates are only one of many parts which wear to such an extent as to lose their efficiency. In most cases these parts can readily be restored to their original size and efficiency either by welding or the advantageous use of shaped applicator bars and welding for the replacing of the lost metal.

THE END

Defense Pipeline Completed

Rough terrain.

A NEW 236 mile oil pipeline for the Standard Oil Co. of New Jersey from Portland, Me., to Montreal, has been completed as a result of the untiring efforts of 1700 men employed on a schedule of 7 days a week. This $8,500,000 pipeline was built under the impetus of National Defense needs and it is believed that it will save 10 to 12 days for oil tankers by permitting them to unload Montreal oil cargos at Portland. From Portland the oil will be transported over line through a 12 in. steel pipeline aided by 8 pumping stations working at 700 lbs. pressure to Montreal. These pumping stations are located at South Portland, and near Raymond and North Waterford, Me., Gorham and Riverton, N. H., West Burke, Vt. and Highwater and St. Cesaire, Que. The stations are spaced about 30 miles apart with arrangements for bypassing any station in case of power failure.

A most difficult task was completed on time primarily because the speed of arc welding used in making the joints offset delays due to transportation difficulties and variations in trench excavation. A total of 32,700 tons of 12 in. dia. ⅜ in. wall pipe in random 40 ft. lengths was used in building this line. There were 4 slack loops per mile to allow for expansion and contraction. The entire line was covered to a depth of 30 in.

Beautiful scenery.

All of the welding was done in position with each joint welded individually. Differing from "firing line" procedure in which long sections of pipe are placed on dollies and the whole section turned during welding, the position method is said to be particularly advantageous in rough terrain. Using two weldors at each joint approximately 30 minutes were required to make the 5 passes or beads, required per joint. For the first pass or "stringer" and the second pass or "filler" $\frac{5}{32}$ in. electrodes were used. For the third, fourth and fifth passes, termed "filler," "stripper" and "finish" the electrode size is $\frac{5}{16}$ in. Approximately 3,000 ft. of line was completed each day.

The completed pipeline is capable of handling 50,000 barrels of crude per day. Since the average tank car carries 250 barrels, the line each day will pump the equivalent of 200 tank cars full of crude oil. The oil is pumped over the entire distance at a speed of approximately 3 miles per hour.

Two welders per joint.

All Photos Lincoln Electric Co.

★ AIRCRAFT

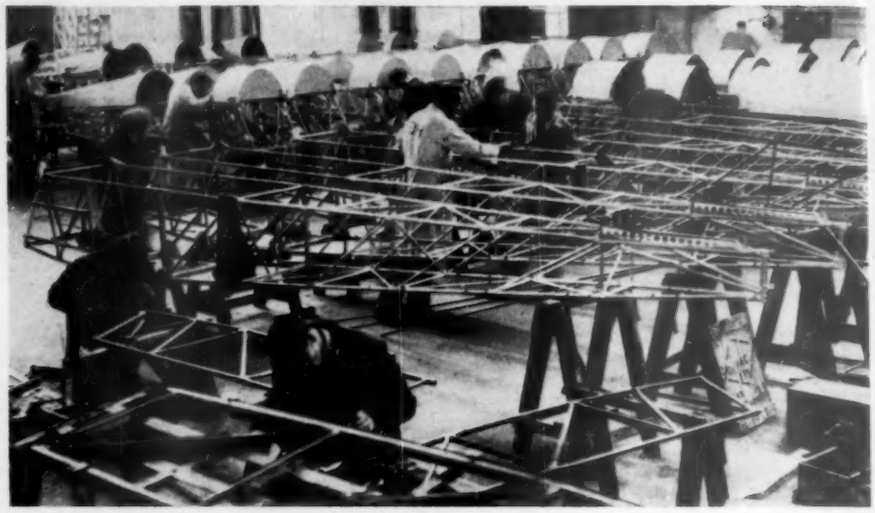


Fig. 1. — Large-scale production of aircraft fuselages in a Canadian plant where trainer planes are being built.

Welding in Aircraft Construction *and Maintenance*

By **A. K. SEEMANN**
Engineer, The Linde Air Products Co.

Rapid changes in aircraft design has brought problems to the industry. In this article it is pointed out, however, that in many cases oxy-acetylene welding, procedure control, and proper inspection offer a ready solution to the difficulties.

THE past decade has witnessed a number of changes in the design and fabrication of aircraft. This, as should be expected, is normal and finds analogy in the growth and development of the automotive industry. There is this distinction between the aircraft industry and the automotive industry however. In the aircraft industry fundamental design changes develop so rapidly that there is no opportunity to set up a production line for even a matter of months. The best planes of today are obsolete tomorrow, and design changes take place even while the planes are being manufactured. As a result, despite the aircraft production figures published, the building of today's airplanes is largely a manual job with little opportunity to incorporate standard economical procedures such as are common in more completely developed industries.

In view of these facts the aircraft industry is to be complimented not only because this country produces the finest planes in the world but also because these planes have been produced under handicaps not found in other industries. The aircraft manufacturer has learned that only change is constant, and has learned to accommodate manufacturing facilities to this constant change.

*Presented at the Twenty-Second Annual Meeting of the American Welding Society, Philadelphia, Pa., October 20-24, 1941.

The earliest planes employed stick and wire structural members. Then, during the first World War, the welded tubular steel fuselage was developed, and more recently the stressed-skin monocoque fuselage of riveted aluminum alloy has come from the designer's board. The end is not here, for the airplane of tomorrow—of a size not now conceivable—may well be large enough to justify the high strength-weight ratio of welded alloy steel in monocoque structures. At the present time important highly stressed and heavily shocked structural members of military and commercial aircraft are of welded construction. To date the welded tubular steel fuselage remains supreme in the field of civilian and training planes.

It has already been mentioned that the building of modern aircraft is a manual task and likewise aircraft welding is a manual task. Being manual the process must be so supervised that uniformly good results will be obtained. This has been assured by the adoption of a procedure control for each job; in other words, a written specification which includes the essential elements of:

1. Design for welding
2. Selection and inspection of materials
3. Establishment of a procedure which will give the results desired
   (a) Preparation of material
   (b) The welding procedure
4. Qualification of the welding operator to follow the procedure
5. Inspection and testing of completed work

It is not the purpose of this article to discuss the several procedure-control principles in great detail. Rather, an effort will be made to present detailed information on cer-

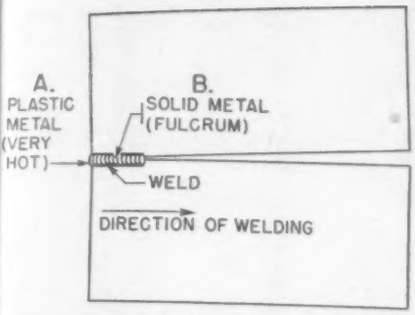


Fig. 2.—Since point A has less metal surrounding it to carry off the heat of welding than does point B, it solidifies more slowly, even though it is welded first. While A is still molten, B has solidified and acts as a fulcrum about which the remainder of the plate draws together as the weld progresses. This force, added to the natural shrinkage of the cooling metal, tends to pull A apart.

tain of the elements which have been troublesome to both the engineering and production departments.

Design for Welding

Basically the Army and Navy authorities and Civil Aeronautics Board, singly or in combination, have formulated specifications regarding designs and materials covering fundamental designs. We may expect these designs to be improved and refined as new knowledge is developed. However, it is thought that all too often designers and engineers have little fundamental knowledge of welding and assume that any two pieces of metal may be joined regardless of their shape, size, or position. It is easy to label a drawing "weld here" but often it is difficult to fabricate the original design. Well-organized plants always consult the welding shop concerning new designs in an effort to make changes compatible with welded fabrication. In common with other methods of joinery the design must include an understanding of the joining process.

The commonest steel used in aircraft construction is SAE X4130. It was selected because of its high physical properties and the fact that it is available in desired shapes and can be fabricated with little difficulty. SAE X4130 is an air-hardening steel which is hot-short, a property which must be taken into consideration if cracking difficulties are to be avoided during the welding operation. Many empirical expedients have been and are being used in aircraft plants but it is believed that a knowledge of the causes of cracking will enable the engineering and production departments to take the necessary corrective measures to insure sound strong joints.

The Cause of Cracks

It is quite obvious to state that cracking results from the liberation of tensile stresses; otherwise there would be no cracking. We may then argue that no cracking will occur if these stresses are absent or are so slight they do not exceed the strength of the metal at any time during welding. In welding, steel is first heated to the fusion temperature. While the cooling, solidifying metal is at a white heat, it is devoid of ductility, because although the individual grains have solidified, they do not cohere to each other. Any slight force will pull the grains apart, air will enter at the grain boundaries and what is termed a "heat crack" will occur.

A study, then, of the forces which are encountered in welding provides a basis for the study of crack elimination. First of all we know that forces are developed through the expansion on heating and contraction on cooling. Secondly, we know that there may be residual stresses in the metal parts themselves, which are liberated by the welding flame. Thirdly, stresses may be introduced in the welding operation. The majority of the "heat cracks" fall into the first group; that is, those developed by expansion on heating and contraction on cooling. Typical of this type of crack is the "edge crack," which starts at an external edge of a part and follows the weld into the part.

Contraction Crack

It is a matter of common experience that when two pieces of sheet metal are butted together or when one is lapped over the other, they will come together in the first instance, or move together scissors-like in the second instance, when welded along the seam of the two edges. A crack is liable to start at the edge where the weld is begun. The following analysis of the forces at work is offered in explanation of a crack of this type.

After the weld has progressed slightly from the starting point at the edge, two forces begin to operate, both tending to stretch the metal at the point where the weld was begun. One of these forces is produced by the contraction of the solidifying metal. This of itself would tend to produce a crack. In addition, the weld metal just inside the starting point solidifies faster than the edge or starting point because of the more rapid conduction of heat away from it by the adjacent metal. The air surrounding the free edge or starting point is a relatively slow cooling medium; consequently, while the initial point is still at a white heat the next interior stage has cooled to a yellow heat. In other words, the edge is lagging behind and is still in the tender or brittle condition when the adjacent stage along the weld is in the tough and ductile condition. This intermediate point acts as a fulcrum, so that the scissors-like action, which brings the edges of the seam together, tends to stretch the white-hot brittle starting point of the weld. Moreover, as already stated, the shrinkage is also stretching the same point, and if the combined effect is great enough, a crack occurs. The manner in which these forces act to produce cracking is shown in the sketch in Fig. 2.

Shrinkage

The considerable amount of contraction which occurs when metal freezes and cools is not generally appreciated. Not considering the contraction of the cooling but still molten metal, and starting instead at the moment of solidification, the metal shrinks about 5 per cent in volume in merely changing to the solid state. An additional contraction of almost 1 per cent then occurs before the temperature has fallen to a yellow heat. Still another contraction of 1 per cent takes place when the metal cools from a yellow heat to ordinary temperature. This sudden and considerable contraction is only one of the stretching or cracking forces that must be controlled intelligently in welding. If the solidifying metal could stretch it would not crack; or, if the adjacent parts could yield, the contraction could be compensated.

Usually cracks are located in the base metal right at the edge of the weld. There are several reasons for this. The principal reason for this particular location is that the section

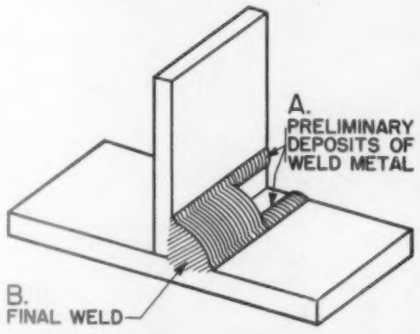


Fig. 3.—As a means of avoiding interior cracking, particularly when thin material is joined to thick material, such as a tube to a forging, the "double-welding" technique can be used. The first step (A) is to deposit weld metal on both materials, along the lines of the outer limits of the proposed weld. The weld metal should be fused with the base metal, but no attempt should be made to obtain deep penetration. The main weld (B) is then made between the two original weld deposits, and fused with them. In this manner an abrupt change in section is avoided, cooling takes place less abruptly since the original weld deposits serve to preheat the base metal, and residual stresses in the base metal are removed prior to the main welding operation.

is thinner than the weld and its shape changes more or less abruptly at this point. In the second place, the base metal, because of its nature, is usually more tender at a white heat than the weld metal. Third, the thin section at the starting point on the edge remains hotter a trifle longer than the thicker, reinforced section of the weld just inside the edge. This is especially true of the lap seam where the double thickness of base metal causes a more rapid cooling rate.

An obvious remedy for the edge-type of crack has been recognized and adopted by some plants: namely, to begin the weld at some point on the seam and weld toward an outside edge rather than to start at an outside edge and weld inward along a seam. A slight compensating compression is thus brought to bear on the weld.

Sometimes the forces operating on a weld compensate or neutralize one another, and since the net result is zero, the metal is not stretched or cracked. In other words, although contraction always takes place, there may yet be forces of compression exerted in the surrounding areas which squeeze the contracting area. On the other hand, external conditions or a combination of circumstances may be such as to exaggerate the cracking tendency. The adjacent parts may be so rigid, either from their massiveness or because of being held immovable, that pure contraction occurs, resulting in a crack.

Interior Cracking

Conditions conducive to another type of cracking, known as interior cracking, can be overcome by a "double-welding" technique, which is particularly useful in joining thick material to thin material, such as a forging to a tube. Welding with this technique is performed in two steps. A deposit of weld metal is first made on both materials to be welded, as shown in Fig. 3(A), following the outer limits of the proposed weld. The weld then is made, as shown in Fig. 3(B), care being taken to terminate the weld within the original deposits of weld metal. In this manner an abrupt change of section is avoided, cooling takes place less rapidly, and residual stresses in the base metal are removed prior to the welding operation.

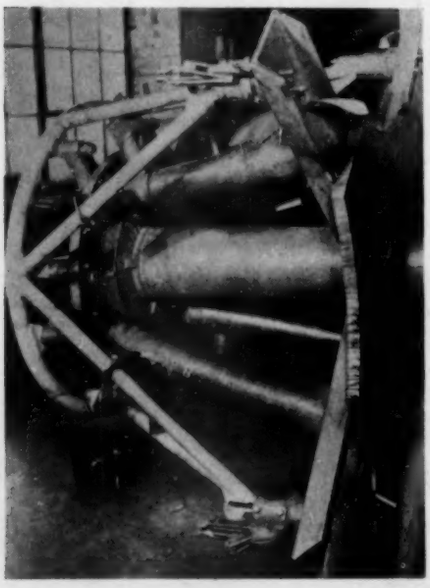


Fig. 4.—A complete engine-mount assembly ready for welding in a welding jig which holds the parts in alignment and positions the assembly for welding. The jig can be rotated, permitting two welding operators to work simultaneously.

Preventing Cracks

It should be appreciated that a weld is a casting and that good casting practice is also good welding practice. In a foundry, for instance, the melting and casting procedures affect the tendency to produce heat cracks, and pouring is performed as near the solidifying temperature as practicable. The welding operator, then should employ similar principles. The welding flame, through proper adjustment, should be slightly reducing or neutral, but in no event oxidizing. The rod should contain beneficial ingredients which will further assist in avoiding oxidization, and for this reason a rod of the same composition as the base metal is seldom satisfactory. Likewise, the metal should not be overheated.

Mention has already been made of the tensile stresses created by contraction of metal on cooling. It may be convenient to compensate these forces mechanically or thermally. Jigs may be so designed that a slight compressive force is exerted during the welding operation but obviously this force should not be of sufficient magnitude to cause upsetting. If the parts to be welded are so positioned that end-wise movement is prevented, the local application of heat to the metal adjoining the weld area produces compressive forces sufficient to compensate for the contraction and thus avoids tensile stress on the part during cooling. This can be accomplished by local heating with the blowpipe, or, as practiced in a few plants, by enveloping the weld in an oxy-hydrogen flame. This expedient has the added advantage of insurance against oxidation, but has the obvious disadvantage of increased welding costs. Entirely satisfactory results are obtainable by local preheating with a properly adjusted oxy-acetylene flame.

Local preheating also serves to eliminate another cause of cracking. Tubing and sheet metal are not always stress-free prior to welding. This condition is brought about by such cold-working operations as straightening, bending, forming, and rolling. Residual stresses resulting from these operations are not usually uniformly distributed, and in localized areas may be sufficiently great to cause cracking if they are released during welding. Preheating these areas locally to a dull red will relieve the major residual stresses, and can be performed as a part of the welding operation.

Fig. 5.—This large side section for a fuselage, made up of heavy tubular members, is also being welded in its special jig. The jig is suspended on end pivots so that it can be tilted to bring the work into the most convenient position for welding.

There is a third cause of cracking which is relatively unimportant, but which should be considered during examination of any cracked parts. If at the conclusion of the welding operation the part is stressed while hot, cracking may occur. Such practices as dropping parts out of jigs, careless or rough handling, and use of improperly designed jigs may cause enough stress to cause cracking.

In review, then, there are three kinds of cracks: (1) those which originate from the heat of welding, (2) those which result from stresses which reside in the metal and are released by welding and, (3) those which are introduced after welding. Understanding of the principles underlying each cause enables the designer or operator to prevent their occurrence.

Selection of Materials

The customary specifications are adequate for selecting aircraft steels but inasmuch as there may be future changes for steels of higher physical

properties, the following remarks may be of interest.

For a number of years the requirements of strength, impact resistance, and ductility were satisfied by medium carbon steel, usually S.A.E. 1025. As higher-strength steel was required a careful search for a steel with the desired properties resulted in the selection of S.A.E. X4130, a chrome-molybdenum steel containing about 0.30 carbon. S.A.E. X4130 has been adopted almost universally and combines the desired physical properties with good machining and welding properties.

However, with aircraft becoming larger, faster and more heavily stressed, designers and engineers are searching for a steel superior to X4130. One steel that offers attractive possibilities is SAE X4340 which is a nickel-chrome-molybdenum steel containing about 0.40 carbon. This steel possesses the desired physical properties and, as normalized, has a tensile strength in excess of 150,000 psi. Preliminary experiments now undergoing confirmatory test indicate that this steel has good weldability, a necessary requirement for all good aircraft steels. Welded joints have been normalized and submitted to tension testing with failure occurring only in the tube. The welding procedure employed with this steel is conventional, a slightly excess acetylene flame being used. Several welding rods have been tried and to date a low-chrome-molybdenum, low-carbon rod has produced the best results.

Establishment of a Procedure

It has been observed that both the establishment of a procedure which will give the desired results and the qualification of welding operators who are to follow this procedure have not been given all the attention they deserve. Frequently the establishment of a procedure is left up to the welding foreman or a man who is considered a "good welder." When the welding has been completed, the welded part is visually examined, checked for measurement, and usually tested by the Magnaflux method. It is then assumed that the part is what the designer expected. However, in well-organized shops where good results are obtained consistently, a conference is held over each new design. Estimates are made of the amount of allowance needed for expansion and contraction, the direction of welding is decided upon, as well as the starting and stopping points. The various parts of the design are then prepared carefully to give a close fit, and the welds are made in accordance with this plan. If difficulties are encountered in the sample parts, the welding sequence is studied again and a new plan evolved. The parts are then subjected to appropriate testing in accordance with the types of stress for which the part has been designed.

The successful application of welding for construction of parts which must be interchangeable or assembled in structures requiring close alignment of parts, as in aircraft construction, requires the use of jigs. These jigs need not be intricate, in fact many consist simply of guides and clamps welded to a base.

With the completion of suitable welding jigs, such as those shown in Figs. 4 and 5, the procedure for welding is marked on the blueprint. These markings include the starting and stopping points of all welds, the direction of welding and the welding technique. All operators are then required to follow this procedure exactly.

Welding Technique

A slightly excess acetylene flame adjustment is recommended for welding X4130 steel. One important reason for this is that the slight amount of carbon in the flame has a fluxing action which is of considerable aid in reducing surface oxides; yet such a flame adjustment does not cause carbon pick-up by the base metal. An added advantage of the slightly excess acetylene flame is that it minimizes the overheating of the base metal with the result that the creation of a temperature gradient in the base metal that is sharp enough to cause the formation of martensite frequently is avoided.

In connection with flame adjustments, it is well to point out that most operators know that an oxidizing flame is hotter than either a neutral flame or a slightly excess acetylene flame and sometimes they will allow the flame to become oxidizing in order to speed up the work. This should be guarded against, and it is important, therefore, that the operators be fully informed of the effects produced by various flame adjustments, and that they be cautioned against using an oxidizing flame.

Operator Qualification

In many respects qualification of the welding operator to follow the procedure is the most important part of the procedure control. In welding shops of plants not using a procedure control, practically every welding operator uses a slightly different technique. Some operators weld forehand, while others weld backhand. Flame adjustments vary from slightly excess acetylene to definitely oxidizing flames. The manipulative technique is also subject to great differences between individual operators, and this lack of uniformity serves to explain differences in welding results.

Well-organized shops in the aircraft industry either train their own welding operators or co-operate with the welding schools from whom they obtain them. The fact that welding operators in this industry are confronted with a wide variety of joints calling for variations in welding technique makes it possible to train them gradually but thoroughly. When they are first employed these operators are assigned to work on secondary structures until their proficiency has been determined. As they progress they are assigned to simple primary structures and in keeping with their ability to weld the more complex joints. The engineering and welding departments co-operate by determining the correct welding technique for each job and by giving qualification tests to determine the ability and talents of the operator. These tests are carefully designed to include the commonly encountered joints and will therefore indicate on which types the operator is most efficient, as well as demonstrate his average ability. In order to insure uniformly high-quality work, destructive tests of production parts are made at random and, inasmuch as each weld is marked with the operator's brand, it is possible to identify each one's work, and thus have an individualized control. These tests are made in addition to the customary semiannual qualification tests, which have their effectiveness somewhat reduced by the fact that the operator knows them to be tests, and the test specimens are naturally samples of his most careful work.

Summary

Over a period of years welding has occupied an important position in the fabrication of aircraft. Problems peculiar to the industry have arisen and, where an intelligent application of procedure-control principles has been applied, the desired uniform high-quality results have been obtained. The close co-operation of management and shop is essential and, coupled with the ever-expanding knowledge of the process, no problem need remain unsolved. The industry should not overlook the many plant maintenance applications which are in daily use in other factories throughout the country.

★ COSTS

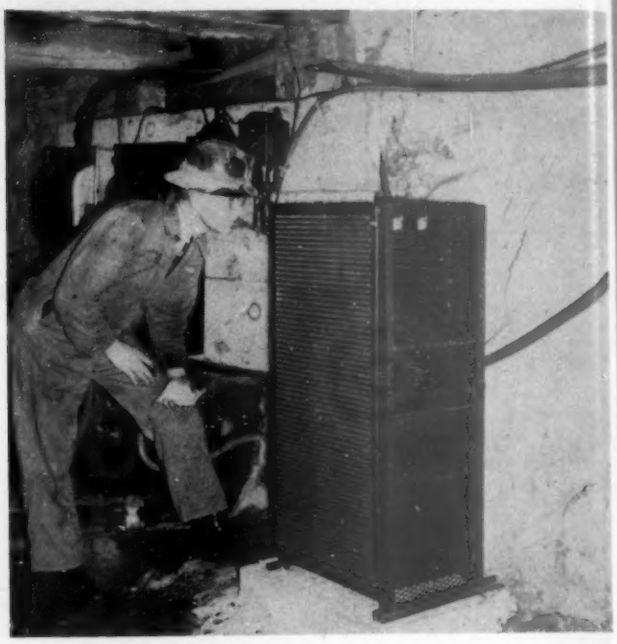


Fig. 1—An indoor rack type capacitor, 60 KVA, 460 v., in service 1000 ft. underground in a California gold mine.

Power Factor Improvement

By **M. I. ALIMANSKY and R. E. INSLEY**

General Electric Co.

A national effort is being made to conserve power so that more power will be available for our war industries. In keeping with this thought The Welding Engineer brings to its readers another article on Power Factor correction. Those in industry who feel that power factor correction principles can be successfully applied to their equipment should investigate the possibilities. High power factor means lower power consumption, lower costs and more power for war industries—The Editor.

Power factor improvement is the fastest and most economical way to increase electrical capacity in a plant. Included in this discussion is a simplified capacitor rating chart.

IF A group of engineers were asked to give a definition of power-factor, it is probable that one would receive many different answers. Each person having his own practical conception of power-factor.

One of the simplest and easiest to visualize is this one: "Power-factor" is the electrical term used to denote the ratio of useful power current to the total supplied current in a circuit. It can be best explained by two simple examples: (1) In an electric circuit supplying a load composed solely of incandescent lights, pressing irons, toasters, water heaters or other equipment containing no electromagnets, 100 per cent of the current supplied is used to produce heat, light, or other beneficial results. This circuit is said to have 100 per cent power-factor. (2) If the circuit contains magnetic equipment, such as induction motors, transformers, electromagnets, etc., current must be supplied to energize them. This current, known as "magnetizing current" produces the magnetic field. Magnetizing current actually produces no useful power but nevertheless is necessary for the proper functioning of the equipment. If the total current in a circuit were 100 amp. and the power current only 70 amp., then the power-factor would be—

$$\frac{70}{100} = .70 = 70\%.$$

Low Power-Factor

The generation and distribution system which supplies the circuit of Example 2 must necessarily provide 100 amp., whereas the actual power current required is only 70 amp. This means that the electric system must be 100/70 or 143 per cent as large as that of Example 1, in order to provide the necessary magnetizing current.

Low power-factor then means that the existing generation, transmission, and distribution facilities of the power companies may be loaded to capacity, or even overloaded, from the standpoint of current, yet underloaded from the standpoint of power being delivered. Since, for the same power delivered, low-power-factor loads impose a greater burden than high-power-factor, power companies have been allowed to introduce into their power contracts kva-demand and power-factor-adjustment clauses which impose an extra charge for low power-factor. In industrial plants, generating their own power, power-factor is extremely significant, since the power which can be drawn for production purposes is limited by the amount of generator capacity taken up by magnetizing current.

Improving Power-Factor

If some device could be found which could be located near the apparatus requiring the magnetizing

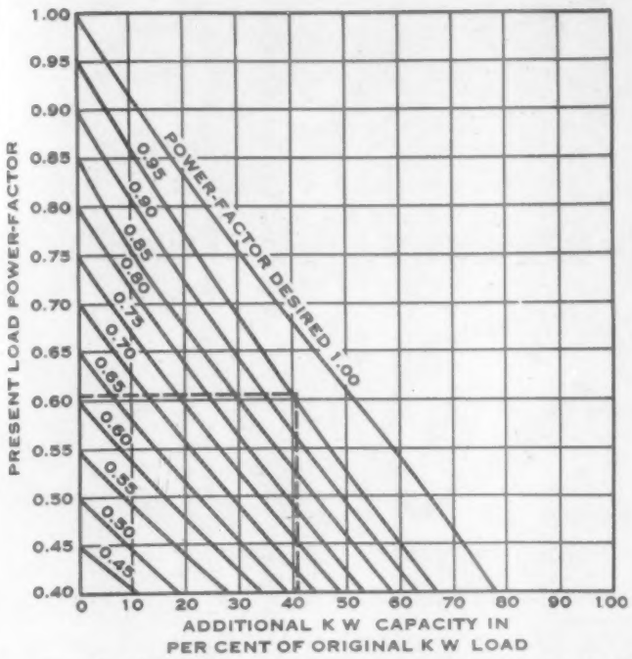


Fig. 2—A simplified capacitor rating chart which is used as follows: Draw a horizontal line from point at left representing power-factor. This line will intersect curve representing desired new power-factor. From point of intersection, draw a vertical line to base of chart and read the per cent of new load which your power system can carry after installation of capacitors.

Example (dotted line): Suppose present power-factor of a 100-kva load is 60 per cent and desired power-factor 95 per cent. Projection of intersection of 60-per-cent-power-factor line with 95-per-cent-power-factor curve shows that 41 per cent new load can be carried after power-factor improvement. That is, 41 kva of new load can be added to present system.

current, a device capable of providing this magnetizing current locally, then it would be possible to eliminate the magnetizing current from the generator and feeders, thus releasing system capacity for additional power load. Such a device does exist in a "capacitor." These capacitors are obtainable in many voltage and current ratings to fit a particular application. When such a capacitor is installed in the electrical system which previously had a low power-factor, the power-factor is improved and the system operates more efficiently and inexpensively.

Capacitor Installations

When it is known a circuit has low power-factor a means for improving the power-factor should be applied near the source of the trouble. It has been determined that a capacitor when connected on circuits with low power-factor will reduce the current requirements between the point where they are connected in the line and the source of supply. Therefore, it is imperative that a capacitor of proper size be installed at or near the terminals of the machine drawing the magnetizing currents.

In selecting capacitors, it is possible to work out the optimum value of capacitor rating mathematically,* but these calculations are laborious, especially when a number of cases are to be computed. "Short-cut" methods have been devised, as shown in the simplified chart, Fig. 2.

*See "How to Determine Capacitor Requirements," *The Welding Engineer*, November, 1941.

Original Power-factor	New load that can be added in per cent of present load with power-factor improved to:		
	90%	95%	100%
60%	35.8	41	51.5
65%	29	35	44
70%	23	28.5	37
75%	17	22.5	30

Condensed Table Showing How Much New Load Can Be Added After Power-Factor Improvement

Conclusion

In many industrial plants, existing circuits, transformers, and switching equipment can be made to carry additional power load by the application of capacitors to improve power-factor. This is especially valuable under present conditions, since capacitors are flexible, inexpensive, and obtainable in relatively short time.

THE END.

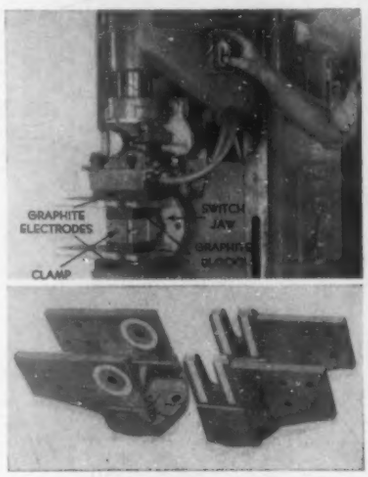
» «

Silver Brazing

The growing demand for silver alloy contact materials in the construction of electrical equipment has necessitated the development of new techniques for attaching these alloys to base metal parts of switch structures. The electric brazing process is proving of value in this connection.

An interesting illustration of the attachment of contact materials to heavy copper castings may be noted in the accompanying photograph of 4,000 ampere disconnect switch jaw and hinge to which strips and rings of silver-nickel contact material were brazed by the Gibson Electric Co., Pittsburgh. Eight strips 1/64 x ½ x 3½ in. were brazed to the jaw and four rings 1/64 in. thick, 3 in. O.D., 2⅛ in. I.D. were brazed to the hinge. Each casting weighed 35 pounds. All of the contacts on each casting had to be brazed at one time; otherwise the bonds of the contacts first brazed might be damaged by the heat required to braze the other contacts.

To accomplish this, the contacts were placed on the casting and the casting held between graphite electrodes of a 50 KVA. Welding Machine, the outer contacts being held by these electrodes. The inner contacts were also held between graphite blocks which were pressed against the contact material by means



Above, electric brazing operation on switch jaw; below, switch hinge (left) and switch jaw (right).

of the wedging clamp illustrated. Very little of the current passed through this inner clamping device because it was bipassed by the base of the copper casting itself. Most of the heat was therefore generated in the outer electrodes and the casting had to be brought up to heat slowly in order to give time for as nearly an even distribution of heat as possible, so that the inner contacts could be brazed before the outer contacts tended to melt. The brazing medium was silver solder which had been applied as a solder flushing on the sheets of silver-nickel from which the contacts were made.

The copper blades of the switches on which the illustrated jaws and hinges were used, were also equipped with silver-nickel contacts. To each blade were brazed 2 strips of silver-nickel contact material 1/64 x ½ x 3½ in. and one ring 1/64 in. thick, 3 in. O.D., 2⅛ in. I.D. In this case, one end at a time could be heated, so the two strips were brazed to one end of the blade at one time and the ring brazed to the other end as a separate operation.

While the case here illustrated involves the application of contact material to large switch parts, the electric brazing method is equally applicable for attaching contacts to smaller parts such as contact fingers, springs, screws, studs, stampings, and extruded sections.

Governing Engine-Driven Welders

By M. L. HEACOX
Sales Engineer
Pierce Governor Co.

One of the main problems in the building and operating of the "home-built" engine driven welder is regulation. Governors are simple yet efficient means for regulating welder power plants. Pointers on their operation are given.

SUCCESSFUL operation of the engine driven welder depends to a large extent on the ability of the governor to respond to engine load changes. The best generator and the best engine will perform no better than the throttle controlling device which must maintain the unit at a constant speed under varying load conditions. If the governor is sluggish, slow to respond, and then fluctuates violently with considerable over run and under run, the most skilled weldor can not even hope to turn out satisfactory work.

For the man, then, who is building his own engine powered unit, and the economies and advantages of so doing are often more than justified, a simple understanding of governor operation may prove of considerable value.

Automotive Engines

Before tackling the governor there are some things to be learned about the unit itself. The power plant can be very satisfactorily an *old* engine—but it must be in good condition. The most a governor can do is to open the carburetor valve quickly when a sudden load is thrown on the engine. If, because of poor compression, bad timing, faulty carburetion or any other common ailment, the engine itself can not pick up the load and handle it smoothly, there is nothing that the governor can do. Split second response to load changes depends on the governor getting the throttle open in split second time—but it also depends on the ability of the engine to pick up that load without lag. In building a welder unless its known that the engine is in A-1 shape, it will pay to give it a thorough "going over."

The ability of an engine to pick up a load instantaneously depends too on the proportional amount of the load to the maximum horsepower of the engine. If an engine at a given rpm had a maximum of 100 hp and you suddenly threw on a load of 99 hp, even the very best engine with the most sensitive governor would kill out right away.

The use of a common automotive engine in a welder is not a handicap. For the most part it offers a definite advantage. In many cases the generator demands on the engine is less than half the available horsepower output.

A power curve on a six year old (1936) six cylinder automotive en-

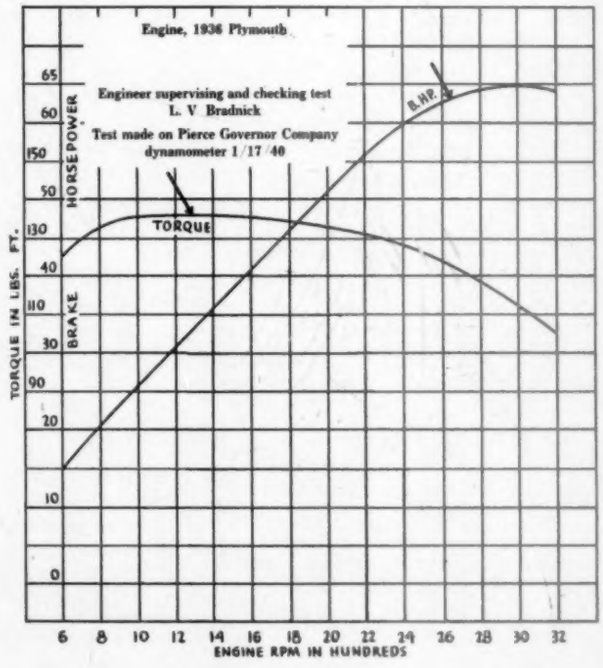


Fig. 1—These torque and hp curves are typical of a used automobile engine in good condition.

Fig. 2—The governor itself (see arrow) is a very small part of the power plant.

gine is plotted in Fig. 1. This curve, made from actual dynamometer operation, shows about what can be expected from a used engine in average good condition. At 1200 rpm the engine will still produce about 30 hp; if operating a generator in the 1800 rpm range there is available about 45 hp. A 300 amp. welder, at 40 V., requires 16.09 hp. At 1200 rpm an engine capable of generating 30 hp is expending only 16 hp. This gives the engine a reserve of almost half and would allow split second recovery after striking the arc. A 100 amp. overload on the same machine would be

$$\text{Volts times Amps.} = \frac{\text{watts}}{746} = \text{hp}$$

$$\frac{400 \times 40}{746} = 21.45 \text{ hp}$$

This load of 21½ hp still leaves 8½ hp in reserve and would give good regulation after the under run at the striking of the arc.

The "Fly-Ball" Governors

In using the word governor reference is made to the mechanical (or flyball) type, the kind of governor generally used for industrial regulation. The first flyball governors opposed centrifugal force with the force of gravity. The early steam engines, you may recall, mounted the rotating flyball shaft in a vertical position so that as the weights revolved faster they swung out and up — on deceleration the force of gravity pulled them down and in.

Spring-Weight Governors

Present governors use this same principle of centrifugal weight force, but instead of opposing the weight with gravity it opposed with a spring. This calibration of weights against a spring allows the governor to operate in either a vertical or horizontal position, and also permits the use of very small weights. A modern governor having weights of only a few ounces each will generate as much as 500 in.-lb. of torque at automotive engine speeds. This means that the governor can be put into a small compact housing and still produce sufficient work force to satisfactorily control an engine.

In order to understand the calibration of a weight force against a spring force we will explain the simple characteristics of each.

Spring Action

Take an ordinary coil spring, extension or compression, and deflect it one quarter of an inch. In doing this, measure the amount of force you have to use to get the required spring movement . . . . say for example it is 20 lbs. Then deflect the spring an additional quarter of an inch . . . . the force will now be 40 lbs. If you deflect the spring another quarter inch the total force will be 60 lbs. The force necessary to compress or extend a coil spring increases directly proportional to the linear deflection; and the increments of force increase, per linear section, is the "rate" of the spring. If in stretching the spring three quarters of an inch the spring force was ten lbs. for the first quarter inch, an additional 10 lbs. for the second, and another 10 lbs. for the third; the "rate" would be given as 10 lbs. per quarter inch deflection. This is what is known as "straight line" increase, as is shown in Fig. 3.

Weight Action

If we could produce a weight force that would fall on, or closely parallel, this straight spring line, we could build a governor that would give good engine regulation from idling top speed. Unfortunately the weight force has a characteristic all its own that makes this impossible. The force increase is not directly proportional to the increase of weight speed, but instead, increases as the *square* of the velocity. On a chart this line will not be straight like the spring line but will be curved sharply upward (Fig. 4).

The idea of calibrating a weight force against a spring force is to find a point where the two forces are in balance so that any divergence from this point will tend to make one or the other predominate. The resultant action of the predominate force will open or close the engine throttle. For example, in an engine governed at 1800 rpm, the governor spring is always trying to open the carburetor valve while the governor weights are always trying to close it.

At 1800 rpm the weight force and spring force are balanced to maintain an even speed. When an additional three or four horsepower load is thrown on the engine. The engine slows down, the weights lose some of their force, this lets the governor spring predominate — and it immediately opens the throttle a little wider. As the engine speeds up the weight force increases until it again balances the spring force. The engine is now running at approximately 1800 rpm again but the carburetor valve is open a little wider to take care of the additional load.

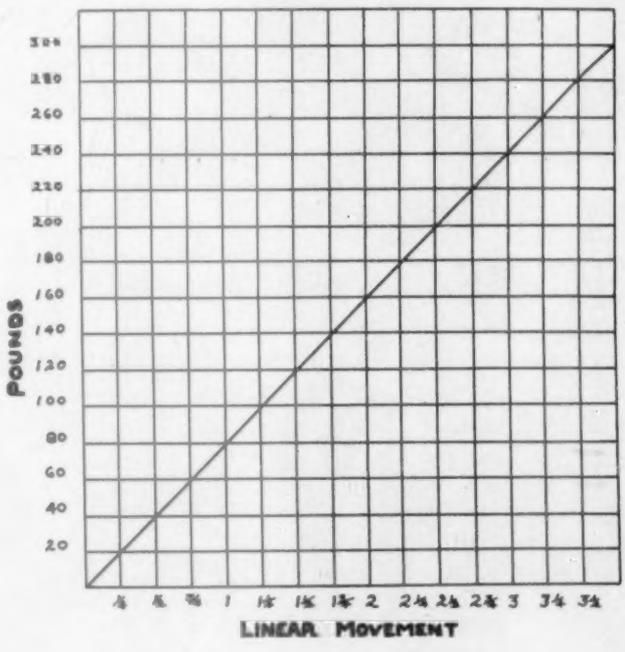


Fig. 3—The compression of a spring is directly proportional to the weight applied.

With the weight force represented by a curved line and the spring force a straight line, (Fig. 5) we can determine the point at which these two lines intersect. At that point a given spring and weight combination will balance and thus give close regulation. For a short distance on either side of that point governing also will be satisfactory—but the farther we get from the point of balance the farther apart are the two lines and consequently the farther out of balance the two forces. With an ordinary compression or extension spring working in a straight line, the satisfactory range of governing is about 200 rpm on either side of the point of balance giving a range of about 400 rpm.

If a governor that had been used on an engine operating at 1800 rpm was installed on an engine operating at 1200 rpm, it very probably would not give satisfactory service unless the weights or spring (or both) were changed, or the governor drive pulley changed so that the governor weights would rotate at their calibrated speed (1800 rpm) while the engine operated at 1200 rpm. Changing the governor drive ratio, within reasonable limits, is usually a very satisfactory procedure; and in cases where the governor runs faster than the engine, generally results in more sensitive regulation.

Regulation Factors

We have explained that the weight and spring forces are carefully calibrated in order to give good "regulation." What, exactly, do we mean by this word?

Regulation is the ability of a governor to hold an engine at a constant, or near constant, speed through load changes. It is expressed in terms of engine rpm, and also as a percent of rpm variation. In terms of engine rpm regulation is the number of rpm change from the lightest load to the heaviest load. For instance, at the lightest load (we will call it "no load") the engine runs 1800 rpm. At the heaviest load ("full load") the engine runs 1750 rpm. The regulation in this case is the difference between the two—50 rpm.

Percent of regulation is the rpm difference between full load and no load expressed in percent of that difference. A simple equation for percent of regulation is

$$\frac{200\ (x-y)}{(x+y)}$$

x = no load rpm, y = full load rpm. The above 50 rpm regulation difference expressed as a percent would be as follows

$$\frac{200\ (1800-1750)}{(1800+1750)} = 2.81\%$$

This is very good regulation indeed is better than the required stability for the most critical welding work. A 50 rpm variation at 1200 governed speed radically increases the percent of regulation (the smaller the percent the better the regulation) and does not offer as sensitive control as at the higher speed.

$$\frac{200\ (1200-1150)}{(1200+1150)} = 4.25\%$$

This is well within the satisfactory limits, as 5% regulation is usually more than adequate for welding work.

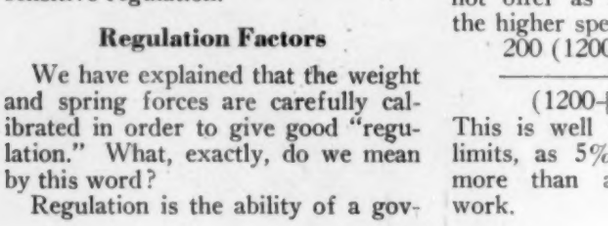


Fig. 4—Centrifugal force increases, not directly but, in proportion to the square of the velocity.

Surging Operation

Although close regulation is desirable for generator control it can be too close for practical use. When this happens a *surge,* or *hunting* condition exists. The balance of forces is so close that the governor over runs in trying to make critical adjustment and is then so sensitively adjusted as to be unstable. Such a governor, although able to give the very closest regulation, is useless because of its instability. Occasionally too, a governor that goes into a violent surge may never settle out, and each swing of the pendulum of under run and over run becomes worse instead of better until finally the throttle is being jerked from wide open to completely closed position.

If the governor has the right weight and spring combination to begin with, this tendency to surge under load can usually be dampened out with a spring eye adjusting (surge adjusting) screw. The spring eye adjusting screw changes very slightly the angular force of the spring and throttle lever, and also slightly changes the linear movement (extension or compression) of spring for a given movement of the fly weight.

No load surge as against the *load surge* that we were talking about, is a different matter. Here the engine "hunts" when it is running at governed speed under no load conditions, that is, doing practically no work. No load surge is often caused by the vacuum-velocity conditions at the governor throttle valve. At no load, even at 1800 rpm, the throttle valve is nearly closed — just barely cracked open. In this position the governor often has to fight an intake manifold suction that wants to pull the butterfly valve tightly closed; as well as the velocity of the gasses pushing down on the butterfly from the top (down draft carburetor). In violent cases the butterfly valve often has to be drilled or slotted to relieve this vacuum differential. At other times merely the addition of a bumper spring in the governor or valve box, to dampen out the oscillating movement of the throttle, will overcome the trouble.

Sluggishness

The reverse condition of the surging governor is the sluggish or slow acting governor. Sluggishness is due generally to a slightly too heavy spring rate; friction in the governor, in throttle rod linkage, or in the valve box. The heavy spring rate would produce sluggishness due to the rpm differential necessary to overcome the increased spring force.

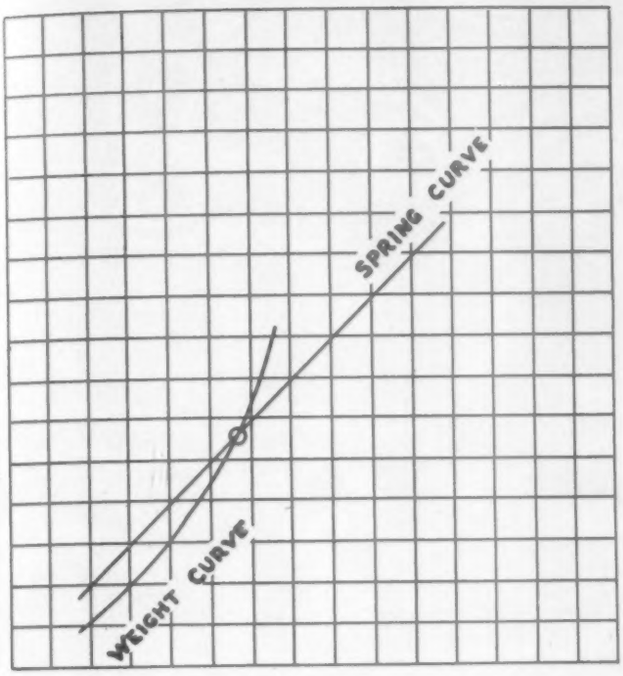


Fig. 5—The intersection of the spring and weight is the point of balance for a given spring and weight combination and thus give close regulation.

Such a governor not only shows a certain slowness to respond but regulation drops off; the difference in engine rpm between full load and no load being considerably greater than for a lighter, properly calibrated spring.

Causes of Lag

If a governor has been operating normally, and then starts to lag the chances are that the fault is not with the weight and spring calibration but is due to wear or friction. Any "stickiness" in the governor or valve box that tend to make the flyweights exert more than normal force to reposition the butterfly valve in response to load changes would, slow down the governor. A simple way to check for throttle lever, rod, and bell crank friction is to unhook the governor spring and move the throttle lever by hand. If it does not move perfectly free the source of the friction should be eliminated at once.

Indications of Wear

Another point that should be brought up is *wear*. After a governor has been out in the field several years, under conditions of rather constant use, the moving parts begin to show wear. A check indicates that wear can be expected in the radial and thrust ball bearings on the revolving flyweight shaft, at the hardened weight noses and hardened thrust sleeve, and perhaps, to a lesser extent, in the rocker shaft assembly. Matching the governor wear there will be an equivalent depreciation in the valve box assembly. The valve shafts, usually of brass or stainless steel, will show the most wear. Throttle rod linkages may appear satisfactory but should be checked for wear that causes a "sloppy" fit. Ball joint fittings, *not the spring loaded variety*, have the advantage of wear take-up and length adjustment and also greatly reducing the chance of angularity friction.

Normal wear is indicated in governor operation by a falling off in regulation, sluggishness, and instability. If at this time it is impossible to tie up the engine for any length of time the governor should be disassembled, carefully inspected and the required replacement parts ordered. The better method, if time is not too important a factor, is to send the governor back to the factory where it can be thoroughly reconditioned by experts who have the proper tools and equipment.

Why not a replacement policy for governor repair? The answer is relatively simple: Governors are not a mass production item—they are an engineered accessory. Almost every new model engine requires a new design, at least, new brackets, pulleys, linkage equipment, and valve box arrangement. Thus new units are built up on customer demand instead of for large shelf stocks, because stocked governors are constantly subjected to obsolescence. Furthermore, a governor in ordinary usage will last the life of the engine, if sent to the factory for repair when the engine is torn down for reconditioning.

After all, a governor is a rather simple mechanical device subject to the ordinary depreciation of normal usage; and requiring the usual average amount of care and knowledge for correct installation and adjustment. Occasionally, of course, like in most other items, a "cranky" one appears that does not respond to the prescribed corrective measures. It must be remembered though, that governor troubles are not as a rule the result of a single factor, but generally the compilation of a number of causes. Friction, belt slippage, poor carburetion—even water in the gasoline has been the cause of many a headache to a service man looking for trouble in the governor.

Don't Forget

In building an engine driven welder remember the governor is of prime importance and an absolute necessity. With some knowledge of its operation, adjustment and maintenance automatic engine control can be assured that will give split second response to striking the arc and close, stable regulation in carrying the load.

It must be remembered that when mounting a governor on a home-built welder the following points must always be checked closely:

1. Be sure that the governor is mounted so that the pulleys are in line.
2. That the throttle rod connections are as frictionless as possible.
3. That the governor is properly oiled.

These may seem like three minor items yet they are the basis for most of the expensive service calls that are experienced in connection with governors.

THE END

Fig. 6—A good governor is an essential part of any engine-driven welder.

WELDING PRIORITIES

By **T. B. JEFFERSON**
Editor

IN RECENT months much has been said about priorities but little has been said or written which tends to convey a general understanding of priorities and their effects on the welding industry. Priorities in themselves are not difficult but the fact that they are new and, in some instances, have gotten off on the wrong foot has necessitated corrective changes. These changes consequently have resulted in some misunderstandings and confusion.

So far there seems to be a lack of understanding of the importance of the welding industry to our War Effort. For this reason it seems that welding has not received the recognition it warrants in priority treatment. On the other hand, it must be remembered that to rebuild our national production on a priority basis requires time. Consequently, all industries cannot be treated as rapidly as those in a particular industry would like to see it.

Welding Preference Orders

Since the introduction of a priorities plan, its importance to the welding industry has been recognized by *The Welding Engineer*. During the period since the inception of priorities, *The Welding Engineer* has exerted every possible effort to have the welding industry placed in a favorable position as far as operating priorities are concerned. So far as it can be ascertained, these efforts on the part of *The Welding Engineer* are beginning to bear fruit. The job is not complete but nevertheless, results have been obtained that are favorable to the manufacturers of arc and resistance welding machines.

To date the following preference rating orders affecting the welding industry have been issued:

P-39 covering materials for the production of arc and resistance welding machines was issued on September 12. P-85 for materials entering into the production of resistance welding electrodes was issued December 3.

On December 18 preference rating order P-100 was issued for the purpose of extending priorities assistance to manufacturers and producers so that they could keep their plants and production machinery in good running order. This order is of particular interest to job welding shops because under section B-3 it permits welding repair shops, blacksmith repair shops, small machine repair shops and other persons whose business is primarily a repair function, to use this order to keep in working order their own establishments. It also permits such persons to procure the necessary tools and other items consumed in the course of their repair business.

Gas Welding Missed

A preference rating order covering materials required by the manufacturers in the gas welding industry is still urgently needed. However, to date no action has been taken to relieve the situation that exists with regard to the manufacture of gas welding equipment. It is difficult to understand how those in charge of our war activities expect to continue to be able to gas weld the parts of airplanes, flame-cut plates for our battleships and do the thousand and one other jobs that are daily thrown upon the welding and cutting torches in all of our war industries. How are the manufacturers of gas welding equipment going to be able to continue in operation if they are unable to obtain material to make these

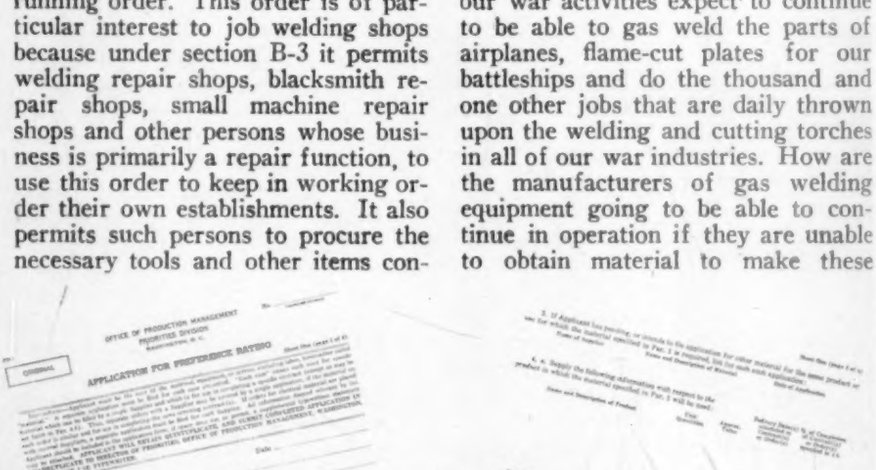

OFFICE OF PRODUCTION MANAGEMENT
PRIORITIES DIVISION
APPLICATION FOR PREFERENCE RATING

Fig. 1—This is the way the first two pages of OPM form PD-1, Application for Preference Rating, appear. Remember, PD-1 is the old standby, use it when in doubt.

torches, regulator, and miscellaneous gas welding items because they do not have priorities to obtain the necessary materials?

In the field of the users of welding equipment and supplies, there is a need for information regarding priorities. Most of the large users of welding equipment, that is, fabricators, manufacturers and large users of welding for maintenance, are familiar with priority regulations. The smaller users, principally the operators of small job shops, however, do not have such a clear understanding of the priorities set-up of our war effort.

The Job Shop Problem

There has been a feeling on the part of many job welding shop operators that maybe they could continue operating but at the same time avoid the confusion of priorities. Many have been successful to operating along this line because others have been doing the "priority worrying" for them. Those who were feeling the "priority pinch" soon decided that it was time to learn something of priorities and were eager to find out what it is all about. This group now finds that they have had a head start because the job welding shop that wishes to keep pace with the nation's war effort must know what to do about priorities.

Priorities

Priorities are with us for the duration and to do business, from now on, we must be prepared to do it with priorities.

Priorities! First of all what are priorities? What do priorities mean in the operation of a job welding shop? Priorities mean that a manufacturer must supply the demands for production or materials for our war effort before supplying products or materials for non-defense or civilian use. It also means that a higher rated preference in defense must be taken care of before the holder of lower rated preferences is supplied. The effects of such a far-reaching order on the job welding shop can be recognized readily. Without priorities or priority orders, a job shop may be unable to get supplies or material to continue to serve its community.

Priority Orders

To the casual onlooker, the priorities set-up at times appears quite confusing. However, there is a definite pattern that is being followed. Once the priorities system was established it was necessary to devise a scheme of priority orders so as to make the system work smoothly. The orders have been classified in one of seven groups which may be defined as follows:

The first of these is called the M order system or the allocation plan. The M orders are designed to regulate the distribution of materials to assure that defense needs will be filled first. Then other users in the sequence of their importance. These orders can be placed on all shipments under the control of the priorities director; set up an emergency pool and allow the balance of the output to go free or to control usage through the rate of production. At present there has been issued M orders numbering from M-1 to M-46.

The P orders or blanket rating orders, which are indicated by letter P preceding a serial number, are intended to give buyers, users or manufacturers defense or civilian needs preference over ordinary civilian requirements in the procurement of material for specified products. The P orders range from P-1 to P-100.

E orders or equipment orders have been designated to regulate the distribution of equipment just as the M orders have been designed to regulate the flow of material. At present the E orders are only two in number and designated as E-1 and E-2.

L orders which are identified by the letter L and are orders restricting the production of specified products and material and set permissible output schedules. They range from L-1 to L-20.

S orders, only one of which has been issued to date, S-1, are issued to suspend a plant's operations completely for a given time for infraction of priority regulations.

PS orders or price orders are the orders that have been issued to establish maximum prices at which various items may be sold. These orders do not set a minimum price. To date 41 PS orders have been issued.

Miscellaneous orders are the last of the seven types of orders that have been set up by the Priorities Board. They cover special conditions which do not lend themselves readily to control by one of the aforementioned types of orders.

Now that we have all these orders, what are we to do with them? The job welding shop on a whole will have very little to do with most of the aforementioned regulations. Their

Fig. 2—PD-1 is a four page form, the last two pages are pictured here. Complete the information and have the form notarized before sending it to OPM.

Priorities are here to stay for the duration. The workings with respect to the welding industry are comparatively simple. Examples of what-to-do in various situations are given.

Transcontinental-Western Air Photo

Fig. 3—Commercial air transports are maintained under preference rating P-100.

principal concern will be with a few of the P orders centering around P-100.

Order P-100

P-100 is a general order covering repairs and maintenance which replaces the old repair and maintenance order P-22 which has been revoked. The difference between P-100 and P-22 are largely technical. However, some of the provisions of the old plan have been liberalized and a number of clarifications have been made in order to eliminate misunderstandings and mis-applications of the order which occurred in the past. This new order, P-100, covers repairs including maintenance and operating supplies as follows:

> Any governmental unit; any individual, partnership, association, corporation or other form of enterprise engaged in one or more of the following capacities to the extent that it is so engaged or so acts; (a) manufacturing, processing or fabricating; (b) warehousing — maintaining warehouses for storage or distribution of any material; (c) wholesaling—acting as a distributor of products sold to manufacturers, wholesalers, retailers or other persons not consumers; (d) charitable institutions—any charitable or eleemosynary institution which is recognized as such for purposes of the Internal Revenue Laws of the United States; (e) carriers—urban, suburban, and interurban common or contract carriers of passengers or freight by electric railway, electric coach, motor truck or bus, including terminals of any of the foregoing; railroads, including terminals; shipping—commercial carriers of freight and passengers by ocean, lake, river or canal, including terminals; (f) educational institutions (including vocational training); (g) printers and publishers; (h) radio — commercial broadcasting and communication; (i) telephone and telegraph communication, including wire services; (j) hospitals, clinics and sanatoriums; (k) petroleum and natural gas—discovery, development and depletion of pools of petroleum and associated hydrocarbons and derivatives thereof, and transportation of petroleum, associated hydrocarbons and derivatives thereof; (l) irrigation systems, whether publicly or privately owned; toll bridges and toll canals.

Priority Advantages

The question now arises "What good are these P orders anyway?" The advantage of a P order is that when you extended to you by a producer under the order it enables you to obtain parts, supplies, and stock replacements on a priority preference rating of A-10 or better.

A-10 — more alphabet and more confusion.

Don't let the A series confuse you. Just remember that this series is merely a guide as to what is important. An order carrying an A-1 rating is more important than an A-2. An A-2 is more important than an A-3 and so on. Even though A-10 preference rating is way down the list (it's 18th) it is still important. More important than a B-1 and much more important than no rating at all. If the work you are doing is for defense, it will undoubtedly carry an A preference rating while non-defense or civilian activities are usually assigned preference ratings in the B category.

The next question is "How can I get a P order for a particular job and have it assigned a preference rating?"

This is just a matter of applying for a preference rating on a Priority Division form of the PD series. So far there have been issues 167 of these PD forms. However, here again the job shop operator is concerned with only a few of them. His main standby will be PD-1 which is the Application for Preference Rating on any particular purchase order. This form which is a four page affair consisting of two sheets, is illustrated in Fig. 1 and 2. It should be filled out and submitted to the Directors of Priorities, Office of Production Management, Washington, D.C. P orders may also be obtained by having one extended to the job shop by a customer who has qualified as a producer.

Doing The Job

To illustrate how a job welding shop will go about using these various forms and priority preference ratings there is given a few examples of typical jobs that might be handled in a job welding shop.

Example 1.

The Problem: The farmer brings a broken cast iron part from his cultivator to a job shop to be repaired. What is the priority procedure necessary to repair this piece? *Doing the Job:* If the job shop owner has materials in stock to do the job, he should do the required work. Since the farmer does not have a priority standing the best thing to do is fill out a form P-100 which the shop itself initiates to obtain replacements. Since this was a cast iron part it undoubtedly would be repaired using a bronze rod. In this case be sure to keep track of the material used so that you can advise your welding jobber so that the bronze material used will get on a PD-25A report which covers scarcity in materials. Since the use of copper is restricted bronze welding rod is classed as a scarce material. If possible to make repairs by a method other than brazing do it, *bronze is too scarce to use carelessly.*

Example 2.

The Problem: An Army convoy is passing near a job welding shop when one of the trucks breaks a frame. The job shop operator is called in to do a welding repair job on this frame. What is the priority procedure to be used in this case? *Doing the Job:* Here again the job shop operator does the job. Since this work is for the Army, the officer in charge will extend to the shop a form PD-3 to cover the work. The job shop operator then extends this PD-3 to his jobber to receive a replacement of the material used in repairing the Army truck.

This PD-1 shows on its face the materials, the rating and the delivery date. Upon being received in the OPM office it is considered and then a perference rating is either granted or the application is disapproved. In the event that a preference rating is granted, it is endorsed, numbered and returned to the applicant. The applicant in turn can extend it to his various suppliers so that he might obtain material under the preference rating that has been granted.

If the job shop obtains a preference rating for work which is straight defense work, that is, for the Army or Navy, it will be extended on a form PD-3 instead of PD-1. If the work is to be performed for a United States Government agency other than the Army or Navy, a preference rating certificate is extended under form PD-4.

Example 3.

The Problem: A farmer calls a job shop operator out to make welding repairs on an irrigation pump he is using to pump water from an irrigation ditch to irrigate his farm. *Doing the Job:* This work would be handled in a manner very similar to that as outlined in the case of the broken cultivator part (Example 1). If this is a registered irrigation system work can be done under P-100 (section L) in which case the shop operator is not required to initiate action.

Example 4.

The Problem: The job shop operator is called by a local utilities company in his village to repair a broken gas main that has developed a leak in a particular section of the town. *Doing the Job:* In this case the job shop operator makes the repairs and relies upon the utilities company to obtain the necessary priorities under P-46 which will be endorsed to the job shop operator so that he will be able to replace his stock which was used in making the repair. The utility company in turn will make a report on PD-118, a form they use for reporting withdrawals of stock supplies in connection with making repairs of the gas main in question.

Example 5.

The Problem: A shovel in a strip mine has broken some crawler track pads and a job shop operator has been called in to make a welding repair of these parts. What is the priority procedure necessary in this case? *Doing the Job:* In this case you make the necessary repairs to the track pads without thought of priorities. The mining company involved has a blanket preference order under P-56 the order which deals with repair and maintenance of mining machinery. This order is endorsed to the job shop operator who will be reimbursed for the materials, so far as possible, that are used in making the repair. The mining company monthly fills out the PD-119 which reports monthly purchases and supply items and repairs on mining equipment as permitted under order P-56 and can replace your stock.

Example 6.

The Problem: A job shop located on the Great Lakes is called upon to make repairs to an ore boat which is operated by the Maritime Commission. What is the priority procedure required to make the necessary repairs on this boat? *Doing the Job:* In repairing the boat which is operated by the Maritime Commission, a preference rating will be extended on form PD-4. The rest of the procedure is that which would be used in preparing the Army truck outlined in Example 2. If the work is done on a boat operated by a commercial carrier it will be on an endorsed P-100.

Just as we will "Remember Pearl Harbor" remember these points concerning priorities.

1. Get a priority rating for every job possible. Get it whether you feel you need it or not, for a priority rating will be extremely helpful in getting materials.

2. Get acquainted with form PD-1 and use it often. Most of your work will fall in this classification.

3. If you don't submit a form PD-25A to the OPM, keep your welding supply jobbers informed as to your anticipated needs of bronze rod, acetylene, oxygen, electrodes and other items that they feel will be scarce. Do this so that they will be able to intelligently report the needs of their customers.

4. When in doubt, consult your local OPM representative. The OPM has established field offices throughout the United States as has the Army and Navy for the purpose of answering problems arising from the application of the priorities system.

5. If still in doubt as to how to operate under priorities, write Priorities Director, *The Welding Engineer*, 506 So. Wabash Ave., Chicago. This servant of the welding industry will help you solve your priorities difficulties.

THE END.

Making Munitions

Production of Bren gun magazines in a Canadian munitions plant has been substantially speeded since the recent installation of two atomic hydrogen welding machines. These machines were custom-built for the precision welding of these vital war weapons parts.

In the original factory at Brno, Czechoslovakia, the welding was done by hand weldors, working at benches. British manufacturers developed an automatic method, however, by which the outside seams of five magazines were welded at one time after all five magazines were clamped in a fixture. Magazines were then placed in another fixture for welding of inside seams individually.

The especially designed atomic hydrogen machines permit welding of both sides of the magazines in one fixture at one operation, effecting an important saving in time.

Photo General Electric Co.

One of the welding machines welding Bren gun magazines

Brief Sketches of Welding Jobs

On the left is shown the manner in which thin gauge materials are warped by conventional form of welding, while low temperature alloys produce a smooth joint as shown at the right.
Courtesy Eutectic Alloys, Inc.

Warpless Brazing

The increased use of welding in the salvaging of delicate machine castings and the welding of light gauge materials has been made possible by the use of a low temperature alloy. These alloy rods in many instances, have stepped up production tremendously. Inasmuch as they are fluid at low temperature, they can be used for the butt joining of material, eliminating the chamfer and thin fillets are suppressed after machining. Likewise, the low temperature avoids the possibilities of warping of the materials for the alloy flows below the critical transformation point of metals and before the formation of critical stresses.

» «

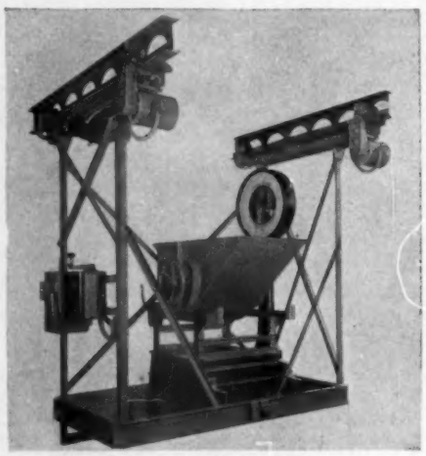
Custom-Built Welder

An engine-driven arc welder mounted in a custom-built portable assembly was recently built for the Missouri Pacific Railroad Co., St. Louis, Mo., by the Machinery and Welder Corp. The unit, built according to the customer's specifications, was constructed for the Bridge Department of the railroad company. Equipped with railway-type wheels, it can be towed over standard gage track, and has a mechanism for setting it off the track when trains approach.

The welder is mounted on an all-welded steel platform which has a 20-inch cat-walk on each side for carrying materials and tools, and upon which welding operators can ride. Insulated main wheels prevent signals from being thrown as the welder moves from one signal block to the next.

The arc welder itself is standard 300-ampere gasoline-engine-driven equipment with a 2-kw, 220-volt, 3-wire auxiliary generator mounted at one end. The auxiliary generator is equipped with a control panel mounting four outlets, two of which supply 220 volts for the operation of small tools; the other two supply 110 volts for the operation of lights.

» «



Simplified yet modern construction is possible with welding.

Batch Scale Car

The Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, is now building a traveling batch scale car, particularly suited for the handling of batch materials entering into the manufacture of rubber and clay products. The car is motor driven and controlled by an operator who rides on a platform space to the left of the bucket.

To simplify its construction and to make it modern in every sense of the word, welded construction has been used throughout. Due to all-welded construction, maintenance cost has been greatly reduced and the equipment is much lighter in weight.

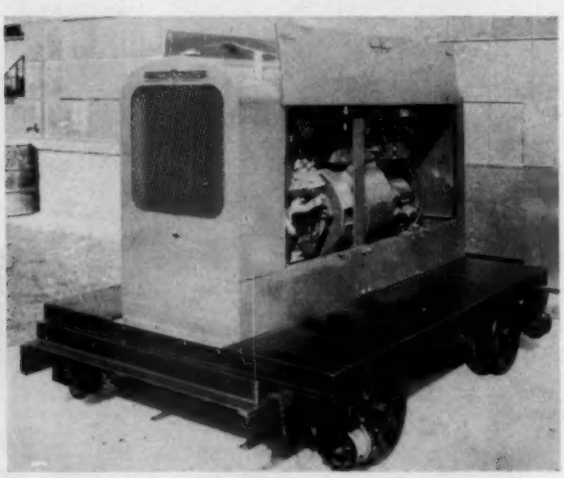
The use of the traveling car makes it possible, to gather the exact amount of materials from various bends to go to make up a batch. The scale on the car accurately weighs the ingredients as they are dumped in. By tilting the bucket, through the use of a crank wheel, the materials are easily emptied into mixing or other machines, as required.

» «

Portable Elevator

No longer is the operation of a hinged portable elevator dangerous. Using all-welded construction, the Lewis-Shepard Co., Watertown, Mass., is now building portable elevators which, because of the light weight of welded construction, permits the raising and lowering of the linked upper section. This heretofore heavy, cumbersome piece which resulted in clumsy, difficult and sometimes even dangerous operation has improved so that operation is easy and safe. A powerful compression spring within a cylinder, plus the lighter weight of the welded upper frame, enables one man to raise or lower the frame quickly.

While the welded frame is much lighter than that which was obtained by previous construction methods, the structure is stronger. These features are combined to make the operation of an elevator safer.



A custom built welder for railroad maintenance work.

Welding permits light weight construction without sacrificing strength.

An Airco Photo

A strong, portable flagpole base.

Flagpole Base

The welding class of the Trade and Industrial Department of East High School, Huntington, W. Va., have constructed a rather unusual base for a flagpole. This base, which is entirely welded of structural steel shapes, is so designed as to enable the pole to be moved from one location to another. It is mounted on skids, the ends of which are upturned to facilitate dragging along the ground. There are also rings welded to the tops of the four corner posts for guy ropes. This flagpole is just another example of the versatility of welding and structural steel.

» «

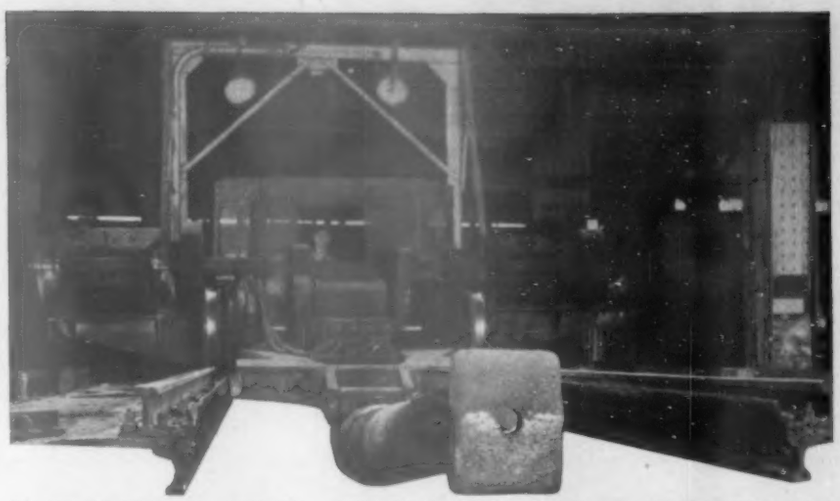
Lincoln Electric Photo

Lightweight cook stoves for the Army.

Army Cookstoves

Among the many products which are being fabricated by welding in our war program is a new portable field cooking range for the use of the U. S. Army. These ranges can be carried by two men without any difficulty and are complete with a supply of oil, cooking containers and other essential equipment. They are being manufactured by Remington Rand, Inc. Safety Cabinet Div., Marietta, Ohio.

The use of electric welding in their construction is reported to have reduced production time considerably. The units are made using aluminum angle frame construction and covered with stainless steel. All that is necessary to fabricate such a range is to cut the material to proper size and then electric weld the joints so that the parts are fused directly together.



READY TO TAKE ABRASION IN 3,000° F!

This device, known as a "peel," is used for charging steel scrap into open hearth furnaces where temperatures hover around 3,000° F. The "peel" itself reaches operating temperatures of 1200° to 1400° while taking heavy abrasive wear.

RESURFACED BY WELDING WITH "HCPF"

It's one of the P&H special purpose electrodes — a medium high-carbon steel with a machinable deposit having high resistance to abrasion — even at these high temperatures.

This user states, "Since using 'HCPF,' peels are only resurfaced about once a month where they had to be resurfaced once or twice a week before."

This is typical of the way P&H answers many special welding problems through this advanced line of welding electrodes.

● *Resurfaced with "HCPF," this peel lifts and rotates pans of scrap steel with total loads up to 5500 lbs.*

P&H WELDING ELECTRODES

For literature on P&H Welding Electrodes, see your nearest P&H distributor or write us direct.

General Offices: 4513 West National Avenue, Milwaukee, Wisconsin

HARNISCHFEGER CORPORATION

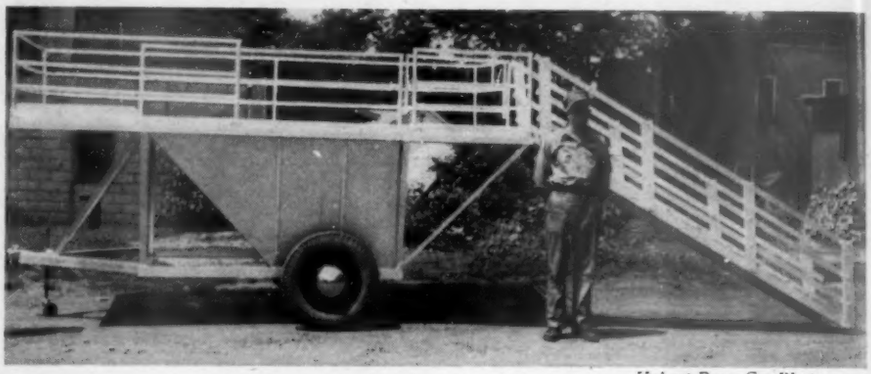
WELDING ELECTRODES • MOTORS • HOISTS P&H ELECTRIC CRANES • ARC WELDERS • EXCAVATORS

Sheep Dip Tank

By K. E. CHANCE

A job shop welder in Henry, Ill., was called upon by a farmer to construct a portable sheep dip tank. As a result the completed job, which is unique in design, costs less than $100.00.

It was fabricated by utilizing arc welding to join lightweight angles. The base and hitch were constructed from 3 x 3 in. angles while the platform train and braces were made of 2 x 2 in. angles. The tank itself was welded from 20 gauge black iron. The floor, the only part of this sheep dip tank to be made of wood was nailed to 2 x 2's timber which had been bolted to the angle frames. Guide railings about the tank were constructed by welding ¾ in. pipe to the frame.



Hobart Bros. Co. Photo

A sheep dipping tank that can be moved about readily.

By constructing a tank for sheep dipping in this manner, it is possible to make the tank either large or small, to fit the needs of the individual customer. The advantages of a portable sheep dipping tank is that it can be readily moved from range to range, thus eliminating the necessity of moving large flocks of sheep.

Portable Storage Tank

By VINCENT E. DIEHL

At the Kansas City, Mo., Rock Products plant, there has been constructed some storage tanks that are believed to be unusual. These tanks, there were four of them, are used to store sand and crush rock. Each has a capacity of 100 tons and is mounted on skids so that they may be moved readily when empty to a new location by means of a small tractor. The only use of bolts in the entire construction of these four tanks was to provide a means of fastening the legs of the skid to the tank structure.

Lincoln Electric Co. Photo

Everything about this 100 ton storage tank is welded with the exception of the leg connections.

Welding Rods . . . not too plentiful, BUT . . .

if you need stainless electrodes for defense work, alloy and hard surfacing rods or other electrodes for special, out-of-the-ordinary applications, we can probably help you. Call the nearest Ryerson plant.

Electrodes in stock include:

McKay Stainless—7 types

Ryerson Shielded Arc — for Mild Steel and Alloys

Blue Coated — For Cast Iron

Phosphor Bronze—For Brass and Copper

Hard Surfacing Rods

Acetylene Welding Rods

●

Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Cleveland. Detroit, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON

The chain prevents cover loss.

Neat Covers

By M. T. Pate

Heavy unitized equipment around the oil-well drilling rig must be provided with eyes, slots or holes for attaching the hook on the winch truck or crane for loading when shifting rig location. Such holes, unless guarded, constitute a safety hazard for the drilling crews.

One drilling department had the welder cut semicircular holes in the end member of the skid, welding short lengths of welding rod across the pieces he removed so they could be set back into place and thus close the openings.

To prevent loss of the small covers, a short length of chain was threaded through the holes, and welded to the center of the bottom of each cover plate. The chain is long enough to allow the covers to be set back when attaching a hook or sling, and stows within the hollow end member when the covers are in place.

A safe, convenient license data holder.

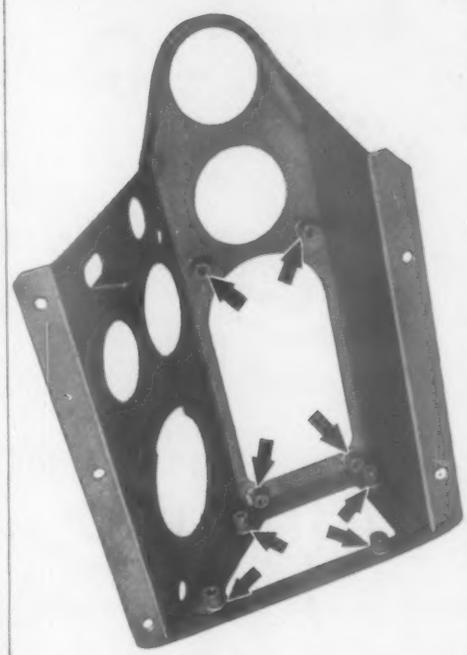
License Data Holder

The two-wheel trailer used in hauling pipe, poles and other long material must be licensed in most states, and license data must be available on demand. Since the trailer does not always stay with the same truck and may be in charge of a number of different drivers, the license papers preferably should stay with each trailer.

One hauling company solved the problem by having welded into a web of the trailer frame a six-inch nipple of 1¼-inch pipe, with a cap screwed tightly to the lower end, and a second cap, provided with a cross bar of half-inch round iron for grip, carried at the top. The license papers are rolled and carried in this holder, being available for immediate showing without having to shift any load. The holder is carried in the frame, below the swing of the bolster, and therefore may be opened simply by unscrewing the top cap.

Another FROM THE THOUSANDS OF DEFENSE PRODUCTION JOBS BEING BRAZED WITH . . . EASY-FLO

EASY-FLO *brazing cuts time on this job over 60%*

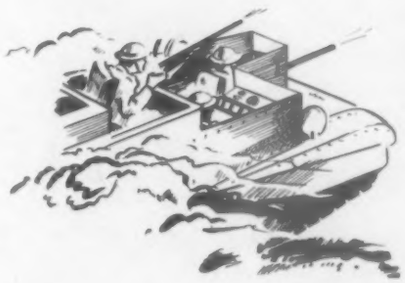


At the left you see a dashboard for a Bren-gun carrier. The job is brazing steel spuds to a mild steel frame. Formerly spuds were positioned with a fixture and then welded on two sides. Now, the spuds are positioned as before but are brazed with EASY-FLO.

Here's what the manufacturer reports the change to EASY-FLO has accomplished—

Time per 1000 panels by the former method—88 hours welding—53 hours for cleaning etc.—total 141 hours.

Time per 1000 panels by EASY-FLO brazing — total 53 hours. Cleaning entirely eliminated. **Estimated reduction in cost per 1000 units $49.50.**



The truly amazing extent to which EASY-FLO is now used is due to the fact that it has speeded up production and reduced costs for nearly every manufacturer who has tried it.

HERE'S HOW YOU CAN QUICKLY FIND OUT JUST WHAT EASY-FLO WILL DO FOR YOU

If metal joining enters into your production it is very likely that you have a number of jobs on which EASY-FLO will give better joints with substantial time savings. If it's defense work, this makes it doubly important for you to get full details. We're ready to do our part by sending a field engineer on request, to help you try EASY-FLO on any ferrous, non-ferrous or dissimilar metal joining job you select. **For full EASY-FLO details write for Bulletin No. 12.**

HANDY & HARMAN 82 FULTON ST., NEW YORK

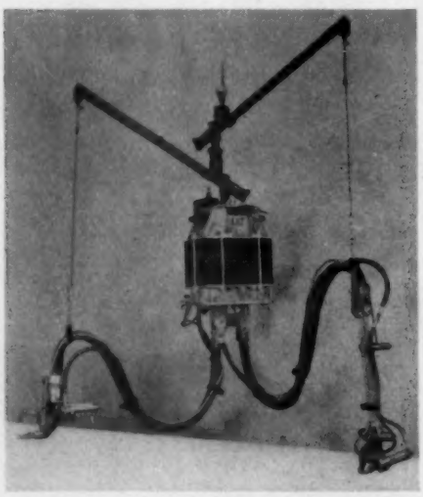
Agents in Principal Cities. In Canada: HANDY & HARMAN of Canada, Ltd., Toronto

New Product Developments

Compound Hanger

★ A line of compound springless, adjustable balanced hangers has been introduced by Progressive Welder Co., 3050 E. Outer Drive, Detroit, Michigan. Of the swiveling type, the hanger permits individual counterbalancing of two separate units, such as welding guns, riveting equipment, and other forms of heavier type 'hand' tools.

The new hangers are individually adjustable for weights to be counterbalanced and are available in two sizes, the **#87DS9** for light and medium duty, and the **#87DS10** for heavy duty. When used with welding guns, for which the hangers were originally developed, the former will support guns and transformers up to 75 KVA, while the heavy duty type is designed for guns and transformers rated up to 150 KVA. No special attachments are required to install the new hangers.



Counterbalanced arms makes welding guns "stay-put" yet keeps them within easy reach.

» «

Lubricant

★ The **Stevens Grease and Oil Co.,** Cleveland, announce a new lubricant known as **Crystal Solid Oil** which has been especially designed for use on the spindle bearings of seam welders. These bearings are frequently called upon to carry current while oft-times actually turning in water. The natural result it is claimed is that it is quite difficult to keep the welding equipment in proper working order where water is used as a coolant because the structure of ordinary grease does not act as a current carrier due to the presence of water in the soap type grease. It is claimed that Crystal Solid Oil is water repellent and does not wash away, consequently maintains a continuous film of protection.

A heavy-duty self-contained portable welder unit.

Engine Driven Welders

★ The **Harnischfeger Corp.,** Milwaukee, has just announced two new **P&H-Hansen gas-driven welder units,** Model WN-150 and WN-200, with capacities of 15 to 200 amps and 30 to 260 amps. respectively. Equipped with the latest type P&H-Hansen self-contained welding generators they are powered by a direct connected heavy-duty 4-cycle, 4-cylinder, V-type Wisconsin gasoline engine. These units are mounted on pneumatic tired trailers with low centers of gravity which permit towing at normal traffic speeds.

These welders are sturdily and compactly built. Hinged side panels allow ready access to generator and engine. When desired, the panels may be swung up and locked in place like automobile trunk doors. Under the canopy recessed compartments provide ample room for storage of cables, operators tools, welding rod, etc. Locks on these panels protect the entire equipment from theft and vandalism.

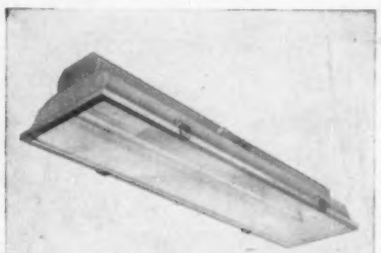
Other features of these welder units include an all-welded steel channel base and a telescopic supporting stand. The stand is designed to support the entire welder unit at a proper level when standing alone. Full information on these new welder units may be obtained by writing: The Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis.

Hinged side panels allow ready access to generator and engine.

Fluorescent Luminaire

★ A new 40-watt fluorescent luminaire is announced by the **Westinghouse Electric and Mfg. Co.** Known as type **FPS-40,** the luminaire uses 2 or 3 40-watt fluorescent lamps per reflector and will provide lighting intensities of from 30 to 100 footcandles with maximum diffusion, minimum glare and uniform distribution at ordinary spacing and mounting heights.

Design of luminaire makes it possible to construct any length of strip desired from four simple and compact types. Channels provide a continuous wireway which may be mounted on conduit, messenger cable, twin-rod suspension or directly on the ceiling. All auxiliary equipment is mounted in the channel. The units have twin-ballasts with built-in compensators providing power factor of 90 per cent or over.



90% or better power factor available.

» «

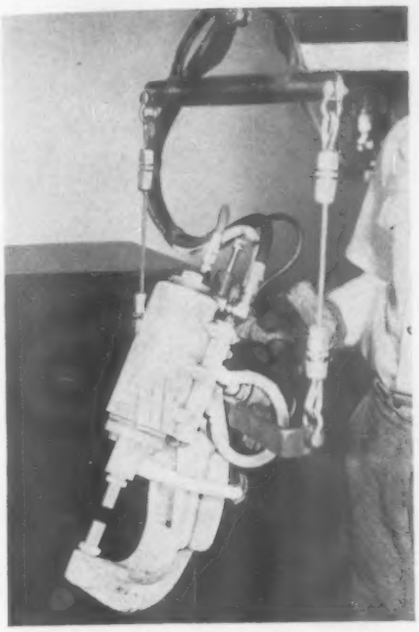
2 to 15 packages per minute.

Container Seal

★ The **A-B-C Packaging Machine Co.,** 221 S. Fourth St., Quincy, Ill., announce the manufacture of **Model 1201 Container Sealer** which is designed to seal containers measuring from 6 to 20 in. in width, 2 to 30 in. in height, to 36 in. in length, at the rate of 2 to 15 per minute. This sealer is quickly adjustable to any of the various sizes.

The complete unit is mounted on casters and can be readily moved to the various departments for shipping. The machine is made in three styles to seal both top and bottom flaps, top flaps only, or bottom flap only. The operations of the machine are guarded so that shrinkage is claimed to have been eliminated from machine sealing.

New Product Developments



The welding goes to the work with this lightweight portable gun for resistance welding aluminum.

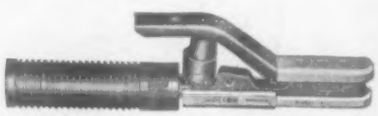
Portable Welding Gun

The **Progressive Welder Co.**, Detroit, announce the development of a portable **Welding Gun** designed for resistance welding of aluminum. This new gun, which has all of its operating mechanism built into the gun head, is available in yokes to fit individual needs. It is claimed that the gun with its transformer, may be used in combination with virtually all control equipment for the welding of aluminum. It is air operated, employing two differential cylinders in a tandem designed to produce a maximum pressure of 1200 psi while using normal factory airplane pressure. Incorporated in the gun head is the manually controlled point retracting mechanism which permits the retraction of one electrode to permit clearing of obstructions. The gun has a maximum stroke of 4 in. When in operation, it is supported by a universal compensating hanger permitting the gun to be positioned at any angle desired.

» «

Electrode Holder

★ **Jackson Products**, Detroit, Mich., announce a change in the design of their electric arc welding electrode holder to include a rod bender. Welders now have a quick, convenient means for preparing the rod for use. The result is faster welding. The Jackson Line includes ten fully and semi-insulated models, ranging in capacity from 200 to 500 Amps.



An electrode bender incorporated in this holder saves time.

Aircraft Torch

★ To specifically serve aviation, the Alexander Milburn Co. announces the release of their new **Type MM Welding Torch.** It is a lightweight designed for aircraft welding.

The Type MM Torch is designed to give best results on thickness of ⅛ in. and less up to ½ in. It is said to be particularly useful with stainless steel and similar alloys requiring exact heat and flame control. Because of its balanced design, it is claimed extremely useful in working around the awkward shapes oftimes confronted in airplane construction.

The MM Torch can be used as an adjunct to the lighter, smaller aviation torch, by using the MM torch to heat the area, and the small torch to weld.

For further details, write the **Alexander Milburn Co.**, 1493 W. Baltimore St., Baltimore, Md.

» «

D-C Welder

★ A new D-C Welder known as the **Flexarc Welder** has been announced by the Westinghouse Elec. & Mfg. Co. This unit, which is closed in a one piece waterproof seal case, is mounted on 4 wheel running gear and is available in 200, 300 or 400 amp. for 220, 440 or 550 v.,

For Smoother Arc Action

The coating on Ampco-Trode aluminum bronze rods has been improved to give smoother arc action. Even inexperienced welders can now obtain satisfactory deposits—beads that adhere better, with slag that is easily removed.

Ampco-Trode is made with the properties of Ampco Metal, and contains all the wear-resistant qualities of this remarkable aluminum bronze alloy. Made in six grades, with hardness from 100-375 Brinell, Ampco-Trode has a tensile strength from 50,000-80,000 p.s.i., and compressive strength from 119,000-171,000 p.s.i. It is suitable for metallic arc, carbon arc, and oxyacetylene welding. Ask for our new Ampco-Trode bulletin.

USES

It is suitable for overlaying steel and cast iron, building up shafts, wear strips, forming and drawing dies, refacing for extreme wear-resistance.

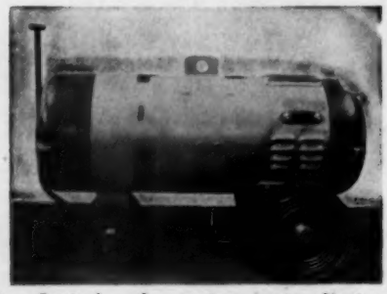
SIX SIZES

Ampco-Trode is made in six convenient sizes — from ⅛" to ½" in diameter.

RESISTANT

to wear on sliding surfaces, fatigue, impact and corrosion.

AMPCO METAL, INC.
Dept. WE-142
MILWAUKEE, WISCONSIN

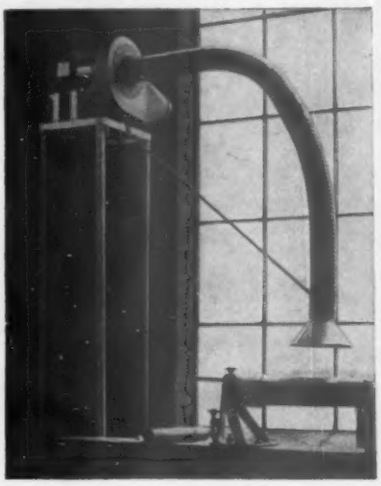


Arc Control and preset current adjustment are features on this new D-C Welder.

2 or 3 phases, 25, 50 or 60 cycle current. This D-C welder features a means of current adjustment which is obtained by a ball crank making it possible, according to the manufacturer's claim, to preset the desired current before starting to weld. This feature is accomplished by a magnetic shunt which is placed in the armature reaction flux path. As the ball crank control is adjusted, the position of the laminated iron leakage block is varied and since this block serves as a magnetic shunt for the reaction flux of the machine, its position with the main flux path determines the welding current. It is claimed that this principle eliminates the need for a field rheostat exciter and external reaction.

The generator is driven by a squirrel cage induction motor and is provided with automatic burn out protection bimetal relay mounted on the motor stator windings.

» «



This small unit will carry away 675 cu. ft. of air per min. at 7800 rpm.

Fume Exhauster

The **Torit Mfg. Co.**, St. Paul, Minn., announce a new fume exhaustor known as the **Torit Fume Exhauster 110**, which has been designed especially for removing welding and metallic fumes but it is also claimed suitable for exhausting fumes, gases, etc., from any source.

The 110 outfit which includes a 1 hp., 3450 rpm. motor and housing mounted on a sturdy base and a fume hood connected to 6 ft. 4 in. flexible rubber tubing. With 4 in. outlets the exhauster is claimed to a capacity of 675 cu. ft. of air per min. at an air speed of 7800 rpm., static pressure 6 inches. These units are available for either 110 or 220 v., 60 cycle, single phase or 220-440 v., 60 cycle, 3 phase current.

» «

Pneumatic Tools

Charles F. Overly Co., 1753 Rosedale Ave., Cleveland, Ohio, announce a new line of **Overly pneumatic tools** for grinding, brushing, sanding or buffing. These tools which are equipped with a standard straight stay-on trigger type handle, are also available with spade or grip handles and straight safety handles. They are available in speeds ranging from 3100 rpm. to 11,000 rpm., depending upon the service for which they are to be used. One of the outstanding features claimed for Overly powered tool, is the governor which is of simple construction and the design for the speeds required and it is claimed will not change through use. The control heads, front head and handles are made of strong aluminum alloy.

High speeds (3,100 to 11,000) which are accurately governed is claimed for this grinder.

Aid National Defense

SAVE STEEL—REPAIR WITH

MANGANAL

(Reg. U. S. Pat. Office. U. S. Patents 1,876,738—1,947,167—2,021,945)

11 to 13½% Manganese Nickel Steel

WELDING ELECTRODES

Bare, Standard and Special Tite-Kote

for building up worn and cracked Manganese Steel Parts

APPLICATOR BARS

ROUND, SQUARE, FLAT, SPECIAL SHAPE

Recommended where deposition of large amounts of metal is required, such as Jaw Crushers, Mantles. R. R. Crossings, Gold Dredge Bucket Lips, Tumblers, etc.

At left: Crusher Plate rebuilt with Round Applicator Bars.

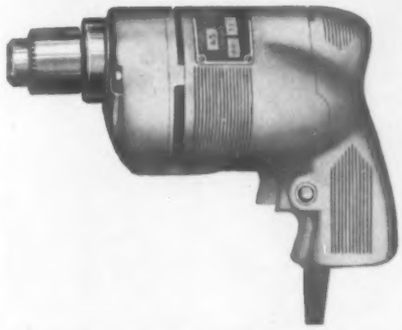
Write for name of nearest distributor

CAST WEDGE BARS

for making Dipper and Shovel Tooth Repointers, Mine and Bulldozer Scraper Blades.

Don't Scrap Worn Equipment—*Repair* with MANGANAL

STULZ-SICKLES CO. Sole Producers **91 N. J. Railroad Avenue, NEWARK, N. J.**



A compact easy-to-handle light weight drill.

Lightweight Drill

★ A new ¼ inch drill, called **Skildrill** has been announced by **Skilsaw, Inc.,** 5033-43 Elston Avenue, Chicago. The new Skildrill weighs only 2¾ lbs., is only 6⅝ inches long overall and only 2⅛ inches wide. It fits most comfortably in the palm of a man's hand for drilling in tightest spots.

In addition to these features, Skildrill incorporates many mechanical refinements such as: Die-cast body; anti-friction ball and needle roller bearings; Helical-cut gearing; Two-pole momentary contact switch with lock for continuous operation and a Universal motor.

Skildrill has a no-load speed of 1800 R.P.M. and a full-load speed of 1050 R.P.M. Drilling capacity in steel is ¼ in. and in hardwood ½ in.

» «

Blackout Paint

★ **Thompson & Co.,** paint makers, Oakmont, Pa., have developed a black paint claiming complete opacity together with weather-resisting qualities and the feature of over-night drying. Introduced as **Thompson's SP 3000 "Eclipse" Blackout Paint,** it comes ready to use, and is applied by either brush or spray. "Eclipse" Paint is a dead flat black that is said to block the passage of light through defense plant windows. Prices on the newly developed blackout paint are said to be in line with durable, quick-drying paint of high quality. Detailed information may be had by addressing Thompson & Co., P. O. Box 6757, Pittsburgh, Pa.

» «

File Reclamation

Special Welding Alloy Co., 27-26 Jackson Ave., Long Island City, N. Y., announce a new service by which files are reconditioned by chemical process. They claim that by their chemical process of reconditioning worn files, it is possible to obtain approximately 80% of the life of a new file from a worn out file, that the files may be reconditioned two or three times and in each case they become as good as new.

Improved Welder Control

★ The **Lincoln Electric Co.,** Cleveland, through the use of an improved and simplified design of its **Dual Continuous Control** system for arc welding machines, claims to have eliminated the need for volt and amperes on their welding machines. It is said that the design of the improved control is such as to achieve the accurate current adjustments required through the use of self-indicating dials.

Another feature claimed for this welder control is that both voltage control (job selector) and current control are in continuous operation. This design provides for thousands of possible combinations of voltage and current. It is claimed that this feature simplifies the setting of the control for an exceptional wide welding ranges as to type of work, welding conditions, size of electrode and thickness of material. In addition to simplifying welding machine operation its elimination of a meter provides a means of reducing the price somewhat, according to the manufacturer.

Tubular flame-cutting made easy.

Here is a tough production problem made safe, fast and accurate with a C-F WELDING POSITIONER equipped with a flexible coupling arm for turning the work at controlled speed on simple rollers without the necessity of accurate alignment.

Better "down-hand" welding on tubes, castings and pipe.

With the same arrangement as above a C-F WELDING POSITIONER takes care of the proper turning of heavy tubular structures while the welder gives his entire attention to the arc and the rod with better fillets as the result.

C-F WELDING POSITIONERS feature:

A table or fixture platen which tilts from horizontal to 135° beyond horizontal: which revolves 360° and which may be raised or lowered as desired on column base of exclusive design. C-F POSITIONERS are made in sizes to meet every requirement. They are described in our circular WP 20. Please write for your copy of this interesting booklet.

CULLEN-FRIESTEDT CO.,
1309 S. KILBOURN AVE. CHICAGO, ILLINOIS

Safety Clothing

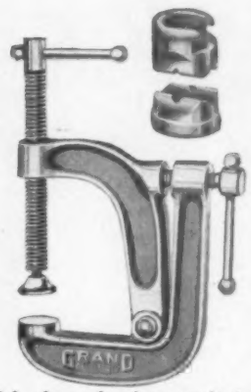
The **Eastern Safety Clothing Co.**, 23 West 60th St., New York City, has placed on the market a complete line of welders' leather protective clothing.

The **Esco line** includes full coats, pants, overalls, rod holders, sleeves, cape with bib attached, cape with detachable bib, spats, aprons (both plain and split type); chaps, etc. These items are made of the finest quality chrome leather and are available in either brown or grey. All are full cut and are said to be guaranteed to be heat-resistant. All items are stock; safety clothing can also be made to order upon receipt of user's specifications. Newly-issued descriptive circular on the Esco line is available.

» «

Pivoted Clamp

A new clamp which incorporates the standard clamp principles with an additional vise feature which is said to provide positive grip, eliminating all surface movement of the clamp or material under pressure, has been announced by the **Grand Specialties Co.**, 3101 W. Grand Ave., Chicago.



A quick clamp for inconvenient places.

This pivoted clamp is designed so that the clamp screw turns at a hang bracket, the hinge acting as a fulcrum at the base of the clamp which has a vise screw working against it. It is claimed that the clamp can be used in inconvenient places not accessible to ordinary clamps and that it will develop a holding power that prevents creeping or shifting even on tapered work. The clamp is available in 3 sizes, with openings of 3, 4 and 6 in. and also with extra slip on jaws for clamping pipes, rods and tubing.

This light weight holder is complete with whip cable and connecting lug.

Electrode Holder

★ The **Tweco Products Co.**, English at Ida, Wichita, Kansas, announce a new electrode holder known as the **Hol-Grip Jr.**

This holder which is fully insulated weighs only 8 oz. and is designed for a capacity of 150 amps. when using No. 4 welding cable. It is capable of receiving any size electrodes from 1/16th in. to 5/32 in. diameter. One of the features of the electrode is the simple clamp connection for attaching the cable which requires no solder. All parts are easily replaceable and the work can be done in the field if necessary. The Hol-Grip Jr. has been especially designed for use in the aircraft field where a light flexible holder is desired. It may be obtained alone or with 5 or 10 ft. whip cables, as desired.

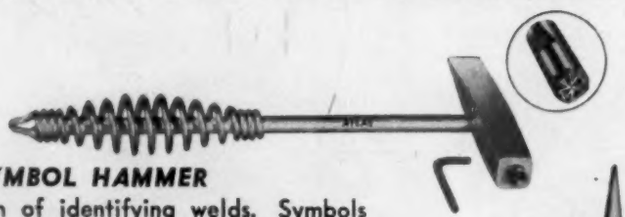
★ATLAS★

WELDING ACCESSORIES

ALL-METAL CONSTRUCTION

ATLAS WELD CLEANER

It's a time saver. Saves carrying two tools. Economical—Bits and Brushes replaceable at low cost.



ATLAS SYMBOL HAMMER

A system of identifying welds. Symbols inserts can be had in Numerals, Letters or choice of 100 different characters.

ATLAS NO. 2. TOMAHAWK

Perfect balance. Built in several weights. Two style heads to choose from.

WRITE FOR ATLAS FOLDER ILLUSTRATING AND DESCRIBING OTHER MODELS

IF YOUR DEALER CAN'T SUPPLY YOU — WRITE TO

Atlas WELDING ACCESSORIES CO.

307 BOULEVARD BLDG. • DETROIT, MICH.

How Far Will A Pound Go?

By T. B. JEFFERSON, Editor

How much coverage of a given thickness per pound of welding electrode can be determined easily and quickly from the accompanying monograph.

"How Much Will It Cost?" That is the question usually asked when a hard-facing job is brought into a welding shop. Similarly, when a weldor is called in to a machine shop to correct a machining error, the question changes to "How long will it take to do the job?" If it takes too long, the piece will have to be taken out of the machine, otherwise the rebuilding job can be done right in the place.

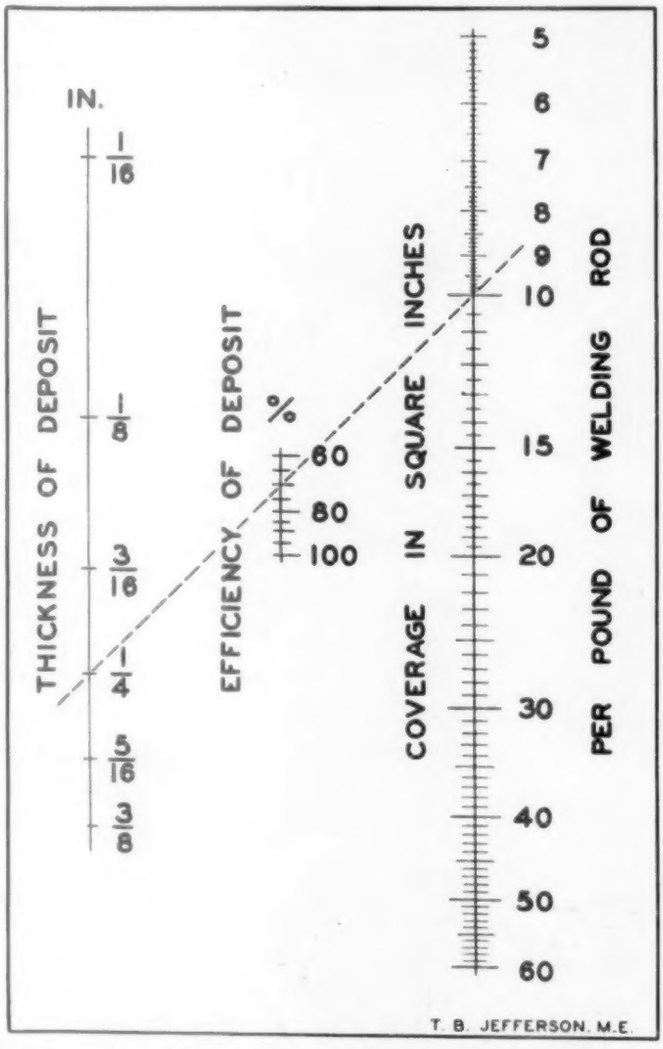
The answer to both of these questions depend wholly upon the amount of material involved. Most weldors know how many pounds of welding electrode they can deposit per hour. Since the sq. in. of area to be covered and the thickness of the deposit required can be determined readily, the only information regarding the job which is lacking is the number of pounds of electrodes that will be required to do the task. If the pounds of electrodes required is known the time involved and the cost of a particular job can be ascertained.

Aided by the accompanying monograph it is possible to determine the number of sq. in. of surface of a given thickness that may be obtained per lb. of welding rod deposited. Then with the number of sq. in. to be covered known it is easy to determine the lbs. of electrode needed.

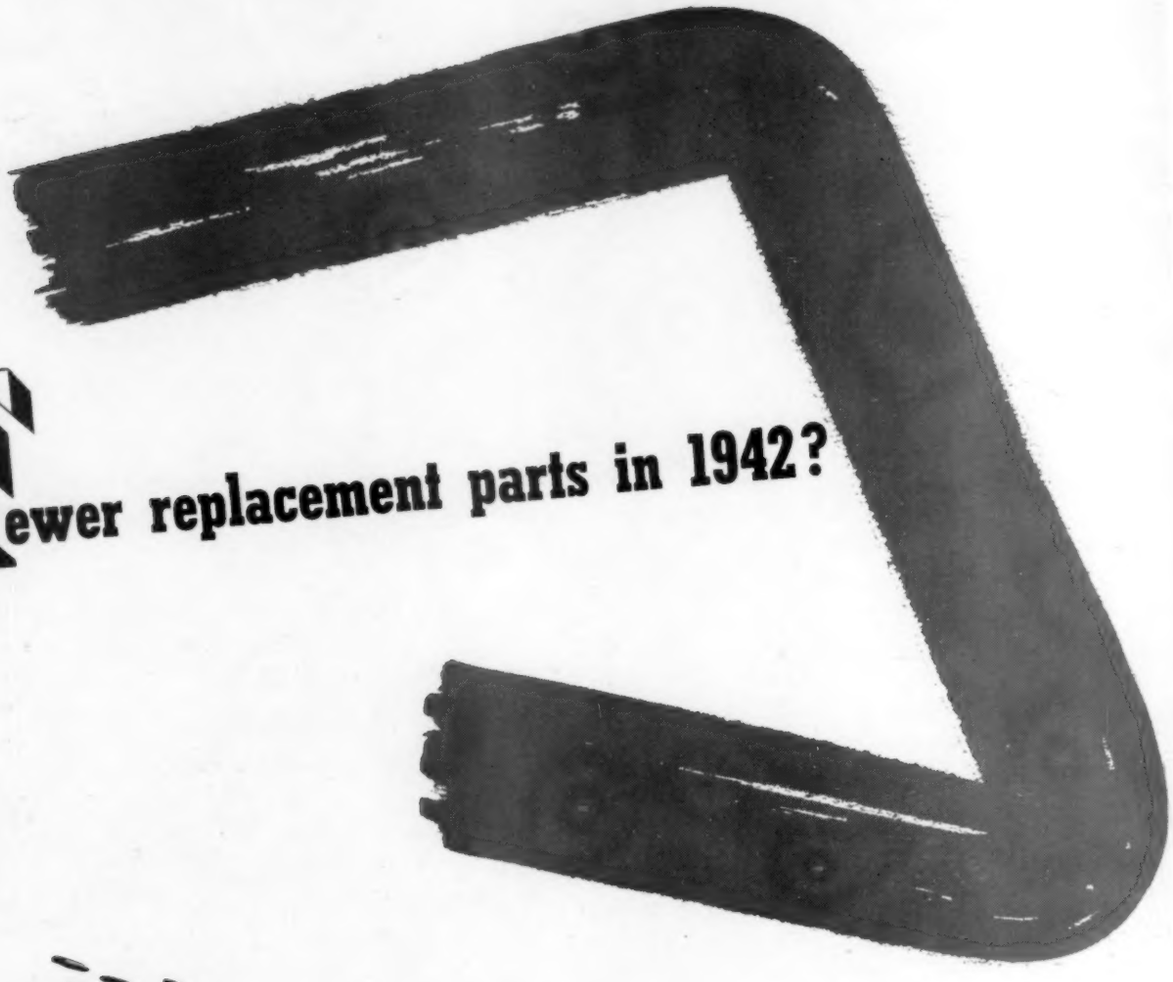
The only unknown in this monograph is the efficiency of the deposit. This can readily be determined by referring to Engineering Data Sheet No. 8.*

Upon having determined the number of sq. in. coverage that will be obtained per lb. of welding electrode, it is a simple matter of determining how much welding rod will be required and how long it will take to do a job from your knowledge of the lb. of rod that can be deposited per hour.

To illustrate the workings of this monograph the following example is solved: Assuming that a deposit of ¼ in. thickness is required and it is known that the welding electrode is 70% efficient. The number of sq. in. of surface that will be covered ¼ in. thick per lb. of electrode deposited will be determined by placing a straight edge so that it connects ¼ in. on the thickness scale with 70% on the efficiency scale. The answer will be found where the straight edge crosses the coverage scale, which in this case is at 10. Consequently a pound of welding electrode that is 70% efficient will deposit ¼ in. of weld metal over an area of 10 sq. in.



*See page 69 of The Welding Engineer, May, 1941.



Fewer replacement parts in 1942?

This war will bring a greater equipment shortage than has ever existed under the present Defense Program. Even those companies now engaged in vital activities may find it increasingly difficult to get adequate replacement parts.

Here is a simple, inexpensive method that not only helps operators and manufacturers conserve *new* steel parts, but also enables them to salvage *worn* equipment.

Wearing surfaces are simply coated with one of the eleven Stoody Hard-Facing Alloys which are available in welding rod form—and are easily applied by ordinary D.C. electric or oxy-acetylene methods. Deposits of these metals attain maximum hardness and abrasion resistance, requiring no further treatment.

Wearing life of equipment thus hard-faced is greatly increased—in many cases as much as ten times! And when wear finally does occur, another Stoody deposit again restores equipment to its original usefulness. Thus the need for hard-to-obtain replacement parts is virtually eliminated, and maintenance costs are considerably reduced.

Without obligation Stoody will gladly send hard-facing literature or recommendations to help solve your wear problems. Write today! STOODY COMPANY, 1134 West Slauson Avenue, Whittier, California.

New Product Developments

Welding Timer

★ A new **Ignitron Welding Timer** known as the SX, a unit consisting of control panel and ignitron tube assembled and mounted in a common closed cabinet, has been announced by **Westinghouse** Elec. and Mfg. Co. This unit has been designed for use where spot pulsation for seam weld timing are required from one timer. Through its operation the electronic tubes and circuit perform 5 distinct functions: 1. On time; 2. Off time; 3. Pulsation counting; 4. Heat Control; 5. Firing of the ignitron power tube. It is so designed so that timing adjustments may range from 1 to 30 cycle steps or so that one to 15 pulsations can be made from one sitting.

An electronic welding timer for use where spot pulsation and seam weld timing are required of one timer.

» «

Electric Hoist

★ **The Speedway,** a new light weight compact wire rope electric hoist has been added to their present line by the **Wright Manufacturing Div.,** American Chain & Cable Company, Inc. The Speedway is obtainable in capacities from 250 up to 1000 pounds. Portability, flexibility and accessibility are outstanding features of this hoist. Like an electrical accessory, it is ready to go to work anywhere. Just plug in on your lighting circuit, or use with conductor systems.

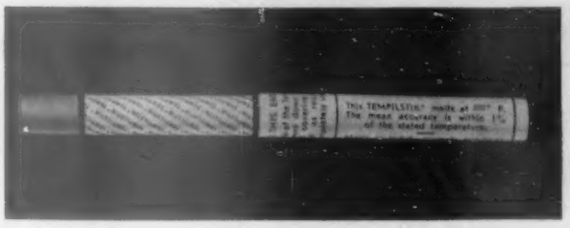
Outstanding features of Speedway construction—push button control, weather-proof, acid-proof, dust-proof, preformed hoisting cable on drum winding, eliminating slack chain fouling loads, safety limit switches, safety load blocks. It is for lug, hook or trolley suspension. Can be mounted parallel or crosswise to runway beam when used with trolley. Furnished for 110 or 220 volt single phase 60 cycle current; also for 220 or 440 volt 3 phase 60 cycle.

» «

Temperature Indicator

★ The **Tempil Corp.,** 132 W. 22nd St., New York City, makers of Tempil° Thermometric pellets, announce a new form of their product, called **Tempilstik°.**

These temperature indicating sticks are claimed accurate within 1%.



Tempilstiks° have a specified melting point. They are available from 125 F. to 1600 F., in convenient temperature intervals, and have a mean accuracy of within 1% of the temperature clearly stamped on each stick or pellet.

Thus a 300 Tempilstik°, drawn across a surface heated to less than 300 F., will

Fractured spokes of 24 ft. flywheel repair welded with Anaconda 997 Low-Fuming Bronze Rod in 56 man hours

When two spokes of this giant flywheel were broken, it appeared as though a blast furnace with scheduled defense production would be out of operation for a long time.

The Hebeler Welding Company, Buffalo, was called in as soon as it was learned that a new wheel probably could not be delivered for a full year.

In just 56 man hours, the Hebeler men completed the job with about 300 pounds of Anaconda 997 Low-Fuming Welding Rod. An insurance company then insured the repaired wheel, which once again proves the statement that good workmanship plus a good material equals dollars —and time—saved! 41137

ANACONDA *Anaconda Welding Rods*

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

leave a chalklike mark . . . which melts sharply into a liquid streak when the surface reaches 300 F.

The new Tempilstik° offers a means of leaving a temperature signal mark on less accessible places, such as vertical, inclined and overhead surfaces. Properly used, each stick will yield up to 1000 temperature determinations. Tempilstiks° come packed in a handy individual tube that fits the pocket and prevents breakage.

» «

Industrial Tubes

★ The General Electric Co., Shenectady announce a newly designed **GL-414 thyratron tube.** It is an all-metal, negative-grid tube for general-purpose industrial applications. Since it has a shield grid, it is said to be suitable for control circuits where the available grid power is very small, and where it is desirable to actuate the grid from a high-impedance source. Typical applications include use in motor controls, welding controls, power rectifiers, and in voltage regulators.

Featuring mechanical strength, ease of installation, and low voltage-drop characteristic of mercury-vapor tubes, the new thyratron has an indirectly-heated cathode rated at 5 v., 20 amp. Maximum peak inverse anode voltage is 2000 v., and average anode current is 12.5 amp.

» «

Forge-welder

★ A new and improved "Forge-welder" has been announced by Progressive Welder Co., Detroit, Mich. This improved unit has had the forging pressure increased so that a total available

Increased rigidity makes higher forging pressures possible.

of 20,000 lbs. per sq. in. is obtained, this pressure being superimposed on the normal electrode pressure to obtain the forge welding action. Both pressure and machine cycle are controlled through an improved sequence timer.

It is claimed that with this new forge welder, it is now possible to obtain excellent welds, free of blow holes on hot rolled sections without the necessity of removing scale or rust prior to the welding operation.

Included as a part of the equipment are dial controls which are said to have greatly simplified the adjustment. They include a phase shift heat control and an automatic current increase control. In operation, the forge-welder applies initial pressure to the electrodes. Welding is by current pulsations. Forging pressure may be applied either intermittently or continuously after the plastic state has been reached according to the automatic control setting.

FOR . . . Strong, dense, tough welds . . . Low Melting Point . . . Easy Flow . . . Good Tinning Action . . . Smooth, easy machinability
ORDER . . . BRIDGEPORT BRONZE WELDING RODS
The quality of your welding work is not a matter of skill alone. The rod you select must be equal to the demands of the job as well. You can depend on the purity plus the reliable, uniform, workable qualities of Bridgeport Bronze welding rods. In one of the world's most modern mills, Bridgeport applies the metallurgical research and development of seventy-five years experience to produce bronze welding rods to top quality standards. When replenishing your stock, get the best by specifying "BRIDGEPORT" to your jobber.
BRIDGEPORT BRASS
BRIDGEPORT BRASS COMPANY
"Bridgeport" BRASS CO.
BRIDGEPORT, CONN. • ESTABLISHED 1865

News of the Industry

American Mining Congress

The annual meeting of the **American Mining Congress** will be held at the Statler Hotel, Cleveland, on February 6, according to an announcement by Julian D. Conover, Secretary.

Members of the Mining Congress from all parts of the country will attend and sessions of the meeting will be devoted to discussions of policies for the coming year and the many problems of the mining industry in meeting wartime requirements.

» «

Welding Conference

The **17th Annual Welding Conference** of the Purdue University was held in the Michael Golden Shops at Lafayette on December 11th and 12th.

A well-diversified program featuring 5 papers during the two day session was supplemented by demonstrations and exhibits. The following papers were presented:

"Salvage and Maintenance"—A question and answer round table.

"Care and Maintenance of Oxy-Acetylene Welding Equipment. **R. B. Jewett,** Linde Air Products Co., Indianapolis.

"Priorities Affecting the Welding Shop." **A. O. Teckemeir,** representative of Office of Production Management. **L. W. Dunham,** Manager of Priorities, E. C. Atkins Co., Indianapolis.

"Training Weldors." **Lt. J. C. Skinner,** Air Corps Training School, Rantoul, Ill. **R. C. Kohlmeyer,** Mechanics Arts High School, Evansville, Ind. **Howard Unger,** West Kankakee Ornamental Iron Works, Kankakee, Ill.

"Machine Gas Cutting for National Defense." **R. F. Helmkamp** and **A. H. Yoch,** Air Reduction Sales Co., New York.

The exhibits which were viewed by a crowd of approximately 500 weldors and welding shop executives from Indiana and Illinois were put on by 10 jobbers in the Tri-State area.

» «

Weldors' Institute

The Division of Engineering at the South Dakota State College, Brookings, South Dak., will present the **Second Annual Weldor's Institute** Jan. 14, 15 and 16, 1942. This three day program is designed to bring to the campus a group of specialists in the field of electric and acetylene welding and to extend the services of the college to all who may be interested in the latest developments of the possibilities of welding. At the same time the South Dakota Ironsmith's Association will hold their annual meeting and election of officers.

The following papers of general interest on welding will be presented during the meeting:

"A Word of Welcome from the Manufacturers," **J. Timmerman,** Linde Air Products Corp.

"Plane Welding with the A.C. Arc Torch," **M. H. Potter,** Marquette Mfg. Co.

"Precautions and Safe Practices," **H. J. Diehl,** Linde Air Products Corp.

"The Business Side of Welding," **L. A. Thesenga,** Smith Welding Equipment Corp.

"Design Methods of Cast Iron and Steel," **E. W. P. Smith,** Lincoln Electric Co.

"Hard Surfacing as Applies to the General Repair Shop," **M. H. Potter.**

"Plate-Edge Preparation (Slides)," **H. J. Diehl,** Linde Air Products Corp.

In addition to the papers there will also be exhibits and demonstrations with various manufacturers of welding and cutting equipment cooperating.

» «

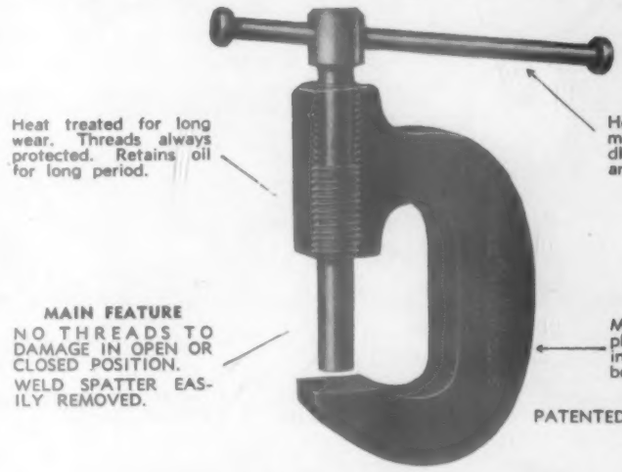
Louisiana Engineers Meet

The 1942 Annual Meeting of the **Louisiana Engineering Society** will be held at the St. Charles Hotel, New Orleans, on January 9 and 10, 1942.

"Red Head"

WELDING CLAMPS

Withstands All Welding and Handling Abuses


Heat treated for long wear. Threads always protected. Retains oil for long period.
Heat treated chrome molybdenum alloy handle offers great resistance to bending.
MAIN FEATURE
NO THREADS TO DAMAGE IN OPEN OR CLOSED POSITION.
WELD SPATTER EASILY REMOVED.
Made from solid steel plate, heat treated, giving great resistance to bending or twisting.
PATENTED

14 STOCK SIZES

Special Sizes and Shapes Furnished for Special Applications

INDESTRUCTIBLE CONCEALED THREADS

Red Head Welding Clamps have been especially designed for welding service. Their construction eliminates the trouble caused by weld spatter or accidental damage to threads. A clamp that will stand up under the most rigorous service over long periods of time.

A trial will convince you. Send for sizes and prices today.

CHICAGO BOILER COMPANY

1965 Clybourn Avenue **Chicago, Illinois**

Refrigeration Meeting

The Stevens Hotel, Chicago, will be the meeting place for the **Refrigeration and Air Conditioning Exhibition** which will be held from Jan. 12th to 15th.

» «

Heating Meeting

The **17th International Heating and Ventilating Exposition** will be held at the Commercial Museum in Philadelphia from Jan. 26 to 30th, 1942.

» «

Trade News

The **Mine Safety Appliances Co. of Canada, Ltd.,** announce the opening of a new office at 139 Kendal, Toronto. This new office will supplement district offices located in Montreal, New Glasgow and Sydney, Nova Scotia in the sales and service of safety appliances in the Dominion from Manitoba to the Maritimes.

« »

The **P. R. Mallory Co.,** Detroit Branch, recently moved into new quarters at 3026 E. Grand Blvd. The new building was especially constructed by the company to meet the requirements of its increasing business and provides about 15% additional space for sales offices and warehouse facilities.

» «

The **Foote Mineral Co.** has recently purchased a new grinding and milling plant at Exton, Pa. The site includes approximately 30 acres of ground serviced by two railroad sidings. Much of the potential capacity of the new plant will be employed to speed up production. The greatly increased storage space, additional grinding units and loading and unloading facilities will aid in storing, processing and handling a greatly increased volume of material.

» «

The **Metalloy Co.,** P. O. Box 3093, Terminal Annex, Los Angeles, Cal., are now the manufacturers and distributors of **Galvalloy,** a galvanizing compound to be brushed on weld seams of galvanized items which was perfected by Galen F. Biery of Seattle.

» «

Personals

Mrs. Hazel M. Hakalow has been elected president and treasurer of the **General Welding Company of Detroit,** succeeding her husband, the late John S. Hakalow, founder of the company. Mrs. Hakalow is one of the few women directing heavy duty industry. A large part of the company's work at the present time is defense work.

Michael Hakalow, brother of the founder of the company, who has been associated with it since it was formed 15 years ago, is vice-president and secretary.

» «

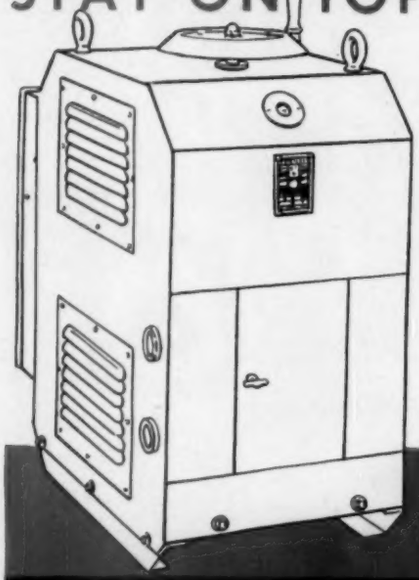
Henry B. Duffus, former supervisor of safety and plant protection at the Westinghouse East Springfield, Mass. Works, has been appointed mechanical safety engineer in the headquarters medical department at East Pittsburgh, it was announced by Dr. T. Lyle Hazlett, medical director of the **Westinghouse Electric & Mfg. Co.**

Mr. Duffus' duties will include safety work at the 24 plants and 33 district manufacturing and repair departments of Westinghouse throughout the country. One of his chief responsibilities will be the continued development of safety devices installed in machines to protect the operators.

» «

Charles E. Adams, New York City, Chairman of **Air Reduction Co., Inc.,** and the United States Industrial Alcohol

STAY ON TOP *with* G-R



When the work's piled high and time grows short, you'll bless the day you put G-R's on your job... for you *know* you're getting the *most welding* out of every hour, every kilowatt of power.

Perfect heat control, no magnetic blow and satisfactory work at higher amperages means faster welding, less spoilage and higher production ...*plus* lower costs because G-R efficiency is high!

If you haven't put G-R's on your job, check now to see which model (from 125 to 2,000 amps, for manual, automatic and Unionmelt) you need.... WRITE, WIRE OR PHONE:

Shown here: new G-R Model 45, 100-625 amp range, for manual or automatic welding. It's a honey! Power Factor Corrected.

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The Improved "Round File" Gas Lighter

Locking "Slip-on" Renewal

—an exclusive feature

The patented cartridge holding the spark metal locks exactly in correct position, permitting instant replacement.

Get acquainted with the many other superior, exclusive features of Improved "Round File."

Circulars and prices on request.

SAFETY GAS LIGHTER CO. (Est. 1901) LYNN, MASS.

Co., has assumed charge of the Iron and Steel Branch, Office of Production Management, it was announced by Director General William S. Knudsen.

Mr. Adams first joined the defense program on June 10, 1940, as Senior Administrative Assistant to E. R. Stettinius, Jr., on the National Defense Advisory Commission. Because of the pressure of private business he resigned from the OPM staff on March 15, 1941, and since has been alternate employer representative on the National Defense Mediation Board. Mr. Adams is expected to make his organization announcements shortly. He replaces Arthur D. Whiteside, President of Dun & Bradstreet, who resigned some months ago but who stayed on during the interim pending the appointment of Mr. Adams.

» «

John Worcester has recently been added to the staff of the **Foote Mineral Co.** in a temporary capacity to direct the remodeling operations of the new Foote grinding and milling plant at Exton, Pa. Graduated from the Massachusetts Institute of Technology in 1930 as a mining engineer, Mr. Worcester has since been engaged in mining operations in Quebec, Alaska, Utah and Bolivia.

E. L. Reed has been added to the staff of the **Foote Mineral Co.**, Philadelphia, as project engineer to do research and development work on milling and concentration problems. Mr. Reed was graduated from the University of Michigan as a chemical and metallurgical engineer and was formerly with the U. S. Gypsum Co. in the capacity of quality supervisor and research chemist. He also spent a number of months doing exploration and underground mining of lead and zinc ores for the Eagle-Picher Mining and Smelting Co.

» «

Election of **T. I. Phillips** as a vice-president of the Westinghouse Electric and Mfg. Co. was announced after a recent board meeting by A. W. Robertson, Chairman. Mr. Phillips started with the Company as a tool maker in 1915 and has been assistant to the president of the Company since Feb. 14, 1941.

A native of London, England, Mr. Phillips was educated in public schools of Lynn, Mass., attended evening school and took a course of apprentice training to fit himself for the job of tool maker.

In 1930, Mr. Phillips was appointed manager of the works department at the Nuttall plant of the Company. Three years later, Mr. Phillips was made works manager for the Company, to serve as control authority for all manufacturing operation. His appointment as assistant to the president, in charge of a headquarters manufacturing staff and supervision of several important divisions of the Company, was made last February.

Don S. Jenkins, a well-known individual in western welding circles, who in recent years has been associated with the welding industry in Salt Lake, announces the opening of his own business known as the **Acetylene Company of Utah.** The Acetylene Company of Utah has its plant located at 366 West 5th North St. The company will manufacture acetylene gas as well as sell a complete line of welding equipment, oxygen and carbide. At present they are manufacturing their own acetylene gas and early in the spring plan to build an oxygen plant of the latest design.

» «

Three new assistants to Sales Manager **J. F. McNamara** have been announced by **The International Nickel Co.** They are **W. J. Calnan, H. D. Tietz,** and **E. A. Turner.** At the same time **H. E. Searle,** who has been Manager, Engineering Sales, for the Monel Department, has received a new post in Nickel Sales. He will aid in the development of precious metal sales.

The titles of Manager, Engineering Sales, and of Manager, Sales Promotion, the latter held by H. D. Tietz, have been abolished. Each of the new appointees will be Assistant to the Sales Manager.

C. J. Bianowicz becomes head of the Chemical Section of Monel Sales to succeed E. A. Turner.

COLMONOY FURNACE WELDING for HIGH PRODUCTION PARTS—

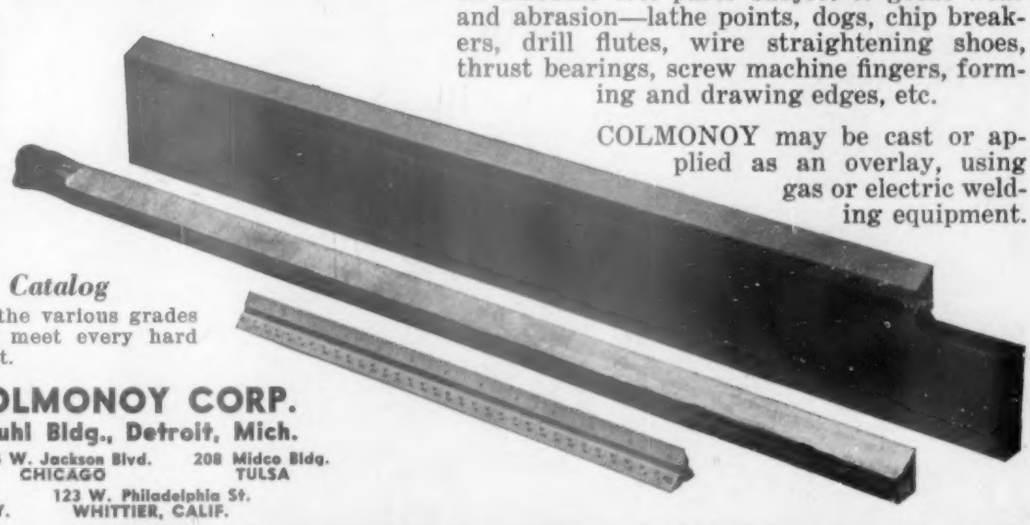
Such as Centerless Grinder Rests

This method consists of applying a casting of COLMONOY NO. 6 alloy to a steel base, by a furnace bonding process requiring no additional bonding material. One of the advantages of this process is its adaptability to high production parts, or intricate parts inaccessible for torch application.

COLMONOY NO. 6 is effecting substantial savings on machine tool parts subject to great wear and abrasion—lathe points, dogs, chip breakers, drill flutes, wire straightening shoes, thrust bearings, screw machine fingers, forming and drawing edges, etc.

COLMONOY may be cast or applied as an overlay, using gas or electric welding equipment.

DEFENSE ORDERS demand that machines stay on the job. KEEP YOUR MACHINERY ON THE JOB by hard facing the wearing parts with COLMONOY.



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Full information on the various grades of COLMONOY that meet every hard surfacing requirement.

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William S. Wilbraham who has been Manager of Sales of **Lukenweld, Inc.**, Coatesville, Pa., a division of Lukens Steel Co., has been promoted to Manager of Costs, according to an announcement by Everett Chapman, President.

Robert C. Sahlin, who has been Assistant Manager of Sales of Lukenweld, Inc., has been promoted to Manager of Sales.

» «

Appointment of **William P. Andrews** as manager of sales, Cleveland district, was announced today by **Carnegie-Illinois Steel Corp.** Mr. Andrews, who has been manager of sales, Cincinnati district, since May 1, 1938, succeeds **F. R. Gammon,** whose appointment as manager of sales, New York district sales office was announced recently. **T. Lane Watson** has been appointed manager of sales, Cincinnati district. Mr. Watson has been assistant manager of sales, Chicago district.

Current Reviews

Arc Welding Booklet

Modern Arc Welding Technique is the title of a new 20 page booklet recently released by the **Lincoln Electric Co.,** Cleveland, Ohio.

This book, which is primarily devoted to the new self-indicating dual continuous control feature which has been installed on Lincoln welders, shows the many advantages of arc welding in industry. The dual continuous control is described in detail as well as are pointers on its operation. There are many illustrations and charts showing the welding current action that takes place in the making of various types of welds. The last half of the booklet is devoted to pointing out the various features incorporated in Lincoln arc welding equipment and describing the machines and accessories manufactured by the company.

» «

A-C Welder Bulletin

A new line of **A-C Welders** introduced by **Larkin Lectro Products Corp.,** 220 Taaffe Place, Brooklyn, N. Y., are described in a 4 page bulletin released by this organization. The three models of A-C welders which they manufacture are described in detail. Information is also given regarding Larkin spot welders, flame torch and special models available. The outstanding feature mentioned in the bulletin is the amperage glide control which is claimed to give settings to half amp. variations. It is also pointed out that the Larkin A-C welders carry a 5 year guarantee against transformer burnout under normal operating conditions.

» «

Capacitor Bulletin

The **General Electric Co.** have released a new bulletin **GEA-3728** which is a 2-page affair discussing G-E Capacitor Discharge Controls for use with stored energy method resistance welding. There is described the advantages, flexibility and accuracy that may be maintained when using capacitors for resistance welding. Information is also given regarding the protective interlocks and the ratings of the various capacitors made by G-E.

» «

Arc Welder Bulletin

In a 4-page bulletin GEA-3726 the **General Electric Co.,** Schenectady, N. Y., describe their new **Strikeasy Arc Welder.** Besides giving the specifications and the many claimed advantages of this new 150 amp. arc welder, information is given regarding the arc welding of aircraft tubing. This particular section of the folder will prove extremely interesting to those engaged in aircraft construction.

» «

Ear Protection

In Bulletin No. CF-4 the **Mine Safety Appliances Co.,** Pittsburgh, describe the new **M.S.A. Welders' Ear Protectors.** These lightweight protectors which resemble ear muffs, are made of cross woven non-rusting screen, leather bound and are deeply cupped of ample size to avoid clamping the ear. It is claimed that they are cool and comfortable and while affording complete protection to the ear from welding sparks, they do not impair hearing.

» «

Low Temperature Welding

"Low Temperature Welding with Castolin Eutectic Alloys and Fluxes" is the title of a 32 page booklet recently released by the **Eutectic Welding Alloys,** 40 Worth St., New York. Based on technical data prepared by R. D. Wasserman, metallurgist and welding engineer, this book not only gives a complete description of alloy welding rods for low temperature welding but also gives important information in connection with work on National Defense, fabricating machine parts, relaying castings, forging and stamping. It also deals with salvaging of defective iron castings, as well as castings of aluminum, bronze, nickel, silver, malleable iron or alloyed steel. Accompanied by illustrations, is given information and technique regarding the use of Castolin materials of various operations described.

» «

Protective Equipment

In a 4 page bulletin the **Mine Safety Appliances Co.,** Pittsburgh, describe the M.S.A. Welding Helmet and other protective accessories for welders. In this profusely illustrated bulletin is pictured the various types of helmets, sleeves, leggings, gloves, aprons and other protective equipment which the Mine Safety Appliances Co. makes exclusively for the use of welders. There is a detailed description of the welder's helmet and the outstanding features which M.S.A. have incorporated in these helmets to make them of more practical use to the busy welder.

Time IS Short!

One way to step-up welding production up to 50% is to use

Ransome

Welding Positioners

. . . now helping hundreds of national defense manufacturers to keep up to or ahead of schedules.

Welding rod economies—better stronger welds—and lowered costs are the other major advantages. A new 12 page well illustrated bulletin shows how. Write for your copy of Bulletin No. 200-B.

Fabricating costs on gear blanks reduced 50 per cent.

INDUSTRIAL DIVISION

RANSOME CONCRETE MACHINERY CO.
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NEW!! TWECO "HOL-GRIP JR"

ACTUAL SIZE— FULLY INSULATED —EIGHT OUNCE

IDEAL FOR AIRCRAFT WELDING

ON ALL LIGHT GAUGE WELDING

Step Up Production * Eliminate Operator Fatigue

Close quarter work can be done much easier with the new TWECO "HOL-GRIP JR." Electrode Holder, companion to 300 Ampere "Hol-Grip Sr." It is compact and takes a positive grip on the electrode at any desired angle. Work spoilage through accidental arcing is cut to a minimum. All Conductor parts are 98% Copper Alloy and the spring is insulated against burnout.

The combination "Hol-Grip Jr." and Whip End Cable is an ideal attachment to convert heavy duty holders for light work. The cable has a connection lug that clamps right into regular heavy duty holders. On completion of light work, the whip cable and "Hol-Grip Jr." can be quickly detached.

SPECIFICATIONS
Weight, 8 oz., Length, 7 in.
Capacity, 150 amperes, Electrodes, thru 5/32

Write for Literature See your Distributor

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Does PRODUCTION like this interest you?

101 EASY-FLO JOINTS PER HOUR!

That's the production one large washing machine manufacturer is getting by taking full advantage of Easy-Flo brazing alloy's **fast brazing action** and a rapid method of heating.

THE JOB . . .

A hex collar of cold drawn steel had to be joined to a steel tube, in the position shown at the right, to form a wringer post. The part is new, but after extensive experimenting Easy-Flo brazing was adopted as the best method of doing the job.

HERE'S HOW IT IS DONE

The operator, after cleaning surfaces to be joined, places the collar on the tube in its approximate position. He then slides a ring of Easy-Flo wire next to the collar and brushes on Handy Flux. Next he puts the assembled parts into an induction heating coil equipped with a fixture so designed that when the assembly is pushed down to the bottom, the collar is accurately positioned. While one assembly is heating, the operator prepares another, resulting in a steady flow of finished parts. Time per assembly is a little over ½ a minute—**101 joints per hour.**

FIND OUT WHAT EASY-FLO WILL DO FOR YOU

Easy-Flo joins ferrous, non-ferrous and dissimilar metals. Its brazing action is **fast** and the joints it makes **strong** and **reliable.** It can be used for a multitude of purposes. If you have a metal joining problem, **try it**—we'll be glad to cooperate. Send us full details and get our recommendations—or ask for a field engineer to call and give full details and a demonstration. Write for our new Bulletin No. 12 giving full details.

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Steel Products Manual

The American Iron & Steel Institute 350 Fifth Ave., New York, have released a revised edition of Section 2 of the Steel Products Manual known as **Carbon Steel Semifinished Products.** The manual is divided into three parts, the first of which refers to the definitions, classifications and manufacturing practices used in the making of semifinished carbon steel products. The second part of the book discusses the types of standard steels as well as includes limits and ranges for non-standard steels. The book is closed giving information regarding standard methods of sampling for check analysis and a glossary of metallurgical terms referring to killed, semi-killed and rimming steels.

Copies of this 30 page booklet may be secured from the Institute at a cost of 25c.

» «

Air Control Catalog

A. Schrader's Sons have just released a new catalog known as **Catalog No. 10** describing the Schrader industrial products for efficient air control.

In this 48 page catalog there is given information regarding the air valves, blow guns, hose couplings, air cylinder, ejection sets, gauges, pneumatic machines and safety devices which are manufactured by the **A. Schrader Sons Co.,** Brooklyn, New York. There is also given information regarding typical hook-ups of various types of equipment and hook-up diagrams and assemblies.

Zinc Coatings

"Possible Substitutes for Zinc Coatings on Steel" is the title of a 24 page pamphlet recently issued by the American Iron and Steel Institute. This booklet, No. 4 of the series "Contributions to the Metallurgy of Steel," is a report prepared by the Institute's Committee on Manufacturing Problems. In this report the subject of substitutes for zinc were considered and discussed in four different phases: (1) Lead base coatings; (2) Metals unavailable or of restricted availability; (3) Non-metallic organic coatings, and (4) Organic coatings.

The information given will be of assistance to the manufacturer in selecting the coatings under the four classifications which are most desirable in the fabrication of his product.

Copies of "Possible Substitutes for Zinc Coatings on Steel" may be obtained from the **American Iron and Steel Institute,** 350 Fifth Ave., New York.

» «

Shell Tolerances

Section 3 of the "Steel Products Manual" entitled **"Shell Steel Tolerances"** has been revised to give the possible users the latest definitions and standards permissible variations for dimensions and workmanship with respect to re-forging steel for shell stock. In a four page pamphlet all information regarding steel shell tolerances has been brought up-to-date since the previous issue of this publication in September, 1941. Information is given on Standard Corner Radii for Round-Cornered Square Sections, standard permissible variations and camber. The text is accompanied by illustrations and tables.

Copies of the pamphlet may be secured from the **American Iron and Steel Institute,** 350 Fifth Ave., New York, for 25c each, postpaid.

» «

Power Switch Folder

A resistance welding power switch called **Weld-O-Trol** is described in a new six-page folder announced by Westinghouse Electric and Mfg. Co.

A schematic diagram shows how the Weld-O-Trol, in sizes of from 150 to 1200 ampere frame, opens and closes the circuit to the primary of the welding transformer. The selection of Ignitron tubes is simplified by a chart giving proper sizes from kva values during the welding process. Installation and replacement of ignitron tubes is described and illustrated. The electro-thermostatic flow switch to protect against water failure or insufficient water flow in the cooling system is explained and illustrated.

A copy of booklet B-3025 may be secured from department 7-N-20, **Westinghouse Electric and Mfg. Co.,** East Pittsburgh, Pa.

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Electric Tools Catalog

The complete 1942 line of THOR Portable Electric Tools is described in an attractive new 64 page catalog just issued by the **Independent Pneumatic Tool Co.**, 600 W. Jackson Blvd., Chicago, Ill. Containing four major sections, the book, known as **Catalog No. 37**, gives complete descriptions, specifications and prices on the entire THOR line of universal type electric drills, drill stands, screw drivers, nut setters, tappers, saws, hammers, nibblers, grinders, sanders polishers and electric tool accessories.

The THOR catalog No. 37 is available to industrial executives, production men and engineers upon request.

» «

Recent Patents

Portable Welder

2,263,038. **Gerhard Hein**, Stuttgart, Germany, assigned to **Daimler-Benz**, Stuttgart, Germany. Filed Mar. 14, 1938. Issued Nov. 18, 1941. For the production of all-steel bodies and the like, the inventor has devised an appliance adapted for producing a series of welding points in quick succession and with uniform spacing. With this appliance, the operator is saved the labor of moving the welder from spot to spot and performing pressing and releasing operations at each. The apparatus comprises a work-supporting conductor, a movable unit having a pair of spaced apart rollers, one of the rollers being positioned in contact with the conductor, and the other in contact with the work to be welded. Thus the rollers are adapted to grip the conductor and work piece between them. Current is supplied to the conductor and the roller in contact with the work piece. A motor is in driving connection with the electrode roller and a revoluble welding current switch is driven by the motor by means of a reduction gearing system. As an example, in the welding of an L flange between two sections, one a horizontal section, and the other a vertical section, the horizontal part rests upon a work-supporting rail conductor. The vertical section is bent L-shape to provide an overlapping portion with the other section. On each side of the lap joint a roller unit moves, the upper one serving as an electrode. Periodically the current switch permits passage of welding current to perform a weld.

» «

Welder's Helmet

2,263,116. **John S. Andrews**, Balto., Md. Filed Aug. 8, 1940. Issued Nov. 18, 1941. This invention relates to an eyeglass attachment for a welder's helmet, the general object being to provide the helmet with lenses made to suit the eyes of the welder using the helmet so that he will not need to use his regular eye-

Eye and Face Protection
DOCKSON CORPORATION
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Forty-seven years of experience as Consulting Brazing and Welding Engineers has gone into building up a line of fluxes that float all oxides and impurities in the joints to the surface, thus producing strong, solid bonds free from pinholes and oxide inclusions; with the greatest economy. Our fluxes have all been developed to meet the particular requirements of the metals on which we recommend them for use.

"KOP-R-ARC" Shielded Copper welding electrodes is our latest development for metallic arc welding Copper, Copper Alloys, Cast Iron and Steel. It produces welds of high tensile strength, ductility and electrical conductivity on Copper.

Use
FLUXINE No. 43
for silver soldering and gas welding all Nickel Chrome Alloys, also for use with all low melting Silver Solders. Meets all U. S. Navy, Army and Air Corps specifications.
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glasses. The helmet has a window and substantially transparent members passing across the window. Suitable eye glass lenses are held in place in a unit in the window, proper circular holes being used to receive the lenses. The arrangement is such that perspiration or moisture cannot reach the lenses.

» «

Spot Welding Timer

2,263,773. **Finn H. Gulliksen,** Pittsburgh, Pa., assigned to **Westinghouse Electric & Mfg. Co.,** Pittsburgh, Pa. Filed July 28, 1938. Issued Nov. 25, 1941. It is an object of this invention to suppress the effect on the timing of a current limiting resistor and the compensating capacitor in the control circuit of the control valve in a welding system. The flow of current from a source to the load requiring power in discrete impulses is precisely timed.

» «

Spot Welding Alloy Steel

2,262,705. **Stiles E. Tuttle,** Balto., Md. assigned to **Rustless Iron and Steel Corp.,** Balto., Md. Filed Aug. 7, 1939. Issued Nov. 11, 1941. In the spot-welding of steels of the type treated in the preceding patent (No. 2,262,693), the process which comprises the steps of spot-welding the steel by passing an electric current of the order of 9,000 amperes or more through the metal sections, giving current densities of the order of 300,000 amperes per square inch or more, to raise the temperature rapidly to that at which welding quickly occurs, solidifying and cooling the weld by interrupting the current flow momentarily while retaining the electrodes in place on the steel, and thereafter reheating the weld to a temperature just below the critical temperature of the steel by passing current of reduced intensity through the electrodes and across the weld to carry out the desired tempering treatment.

» «

Volatile Flux

2,262,023. **Arthur R. Lytle,** Niagara Falls, N.Y., and **Thomas H. Vaughn,** Trenton, Mich., assigned to **Union Carbide and Carbon Research Laboratories,** New York. Filed Jan. 17, 1940. Issued Nov. 11, 1941. A volatile flux for welding or brazing metals is described. The flux consists of an alkyl borate and an alkyl silicate. This patent is related to patent No. 2,262,187, issued to the same inventors and assigned to the same company. The fluxing action is derived principally from boric oxide formed by the decomposition in the flame of the volatile borates. The fluxing action of boric oxide has many desirable features. Thus it provides for the production of clean welds free from the solid glassy encrustations left on the work by the usual solid and liquid fluxes. The use of the silicate increases the fluidity of the weld and facilitates the welding operation. It also increases the corrosion-resistance of welds made with stainless steel.

Welding Method

2,262,423. **Arbert Dreyer,** Lucerne, Switzerland, assigned to **Chicago Metal Hose Corp.,** Maywood, Ill. Filed April 17, 1939. Issued Nov. 11, 1941. There is shown a method of welding a metal assembly by electrical resistance welding which comprises engaging one side of the assembly against a movable electrode, engaging the other side of the assembly against a rotatable electrode, and moving the assembly and the movable electrode together as a unit past the rotatable electrode while passing current between the electrodes to accomplish the weld. In the manufacture of circular shell material, the metal blank is folded around the movable electrode and the combination is moved past a rotatable electrode. The movable electrode also functions as a support for the work to be welded. The apparatus for carrying out this method is also included.

» «

Welding Alloy Steels

2,262,693. **George S. Mikhalapov,** Philadelphia, Pa., assigned to **Rustless Iron and Steel Corp.,** Balto., Md. Filed Aug. 7, 1939. Issued Nov. 11, 1941. In the spot-welding of sluggish, weld-hardenable ferritic and martensitic alloy steels, the improvement of producing a strong, tough and ductile welded junction between metal sections of the thickness of sheet and strip, which comprises applying current carrying electrodes on opposite sides of the metal sections at high

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Carbide

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EFFICIENT

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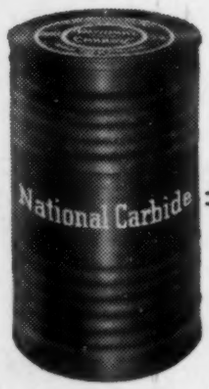

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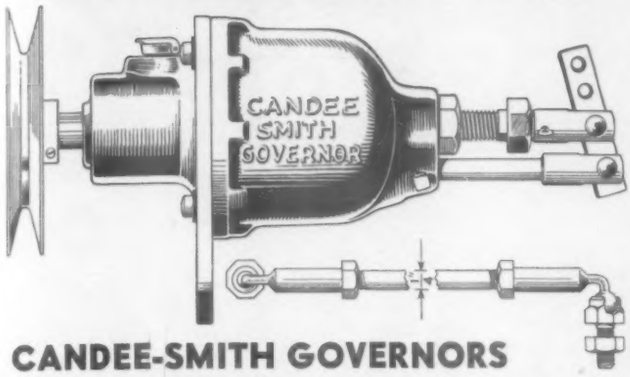
GOVERNORS



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CAST IRON ELECTRODES
MACHINEABLE (COATED)
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NI-RESIST (Coated)

ALUMINUM CAST RODS
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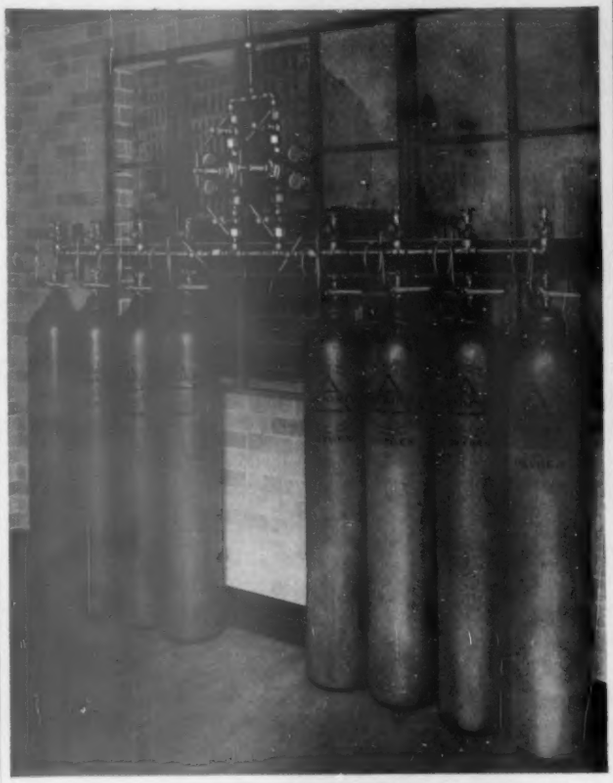

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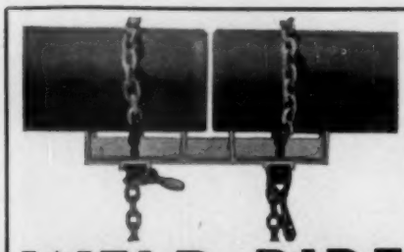

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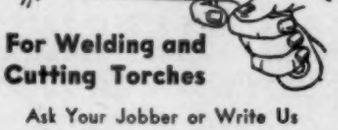

For Welding and Cutting Torches

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SHOOT-A-LITE CORP.
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pressures, passing an electric current through the electrodes and through the metal sections between the electrodes of 13,500 amperes or more for approximately one-sixtieth of a second or less, giving a current density of 500,000 amperes per square inch or more for a time sufficient to ensure fusion between the metal sections in the region of the weld, but of duration so short as to inhibit effectively the development of dendritic crystal structure in that region.

» «

Spot Welder

2,264,047. **Earle B. McDowell,** Scotia, N. Y., assigned to **General Electric Co.,** New York. Filed Aug. 19, 1939. Issued Nov. 25, 1941. In a welding control system, a circuit, means for supplying a timed application of current through the circuit, a condenser, and a unit including a rectifier for charging the condenser to a voltage corresponding to the time integral of the application of current. A bias voltage element in circuit with the condenser and the rectifier is used to substantially neutralize the self-generated voltage of the rectifier. A vacuum tube voltmeter is employed for measuring the voltage of the condenser after the supply means has furnished a timed application of current through the circuit. Patent No. 2,264,067, also assigned to the General Electric Co., and issued on the same date, is related to the subject of this control system.

» «

Ram Type Welder

2,264,825. **Charles P. Bloomer,** Ridley Park, and **Albert D. Canner,** Upper Darby, Pa., assigned to **General Electric Co.,** New York. Filed July 19, 1940. Issued Dec. 2, 1941. In a resistance welding apparatus a ram is provided having a plurality of longitudinal current conducting sections positioned side by side and electrically insulated from one another. These sections are supplied with current. A plurality of electrodes are situated on a welding head at the end of the ram and are movable relatively to the ram, the electrodes being individually connected to the current carrying sections. The ram is movable lengthwise relative to its support.

» «

Current Control

2,265,000. **William E. Pakala,** Forest Hills, Pa., assigned to **Westinghouse Elec. & Mfg. Co.,** Pittsburgh, Pa. Filed Feb. 16, 1940. Issued Dec. 1941. With the development of electric discharge valves, such as ignitrons, capable of carrying substantial current, the practice has arisen of using the discharge valves as high current contactors. The supply of current from a source to a load, such as a welder, is controlled by connecting a pair of ignitrons in antiparallel between the load and the source and controlling the current flow through the ignitors. The opening and closing of a circuit of this type causes arcing at the interrupting contacts. According to the patent a non-arcing arrangement is used for initiating and discontinuing the current.

» «

Skelp Welding

2,265,052. **James L. Anderson,** Closter, N. J., assigned to **Air Reduction Co., Inc.,** New York, N. Y. Filed Mar. 16, 1940. Issued Dec. 2, 1941. Arrangements are made in this patent for connecting the ends of two lengths of skelp which are clamped in abutting relation. The invention includes a torch carriage which runs along the same frame to which one of the clamping members is connected and that moves a welding torch located a short distance above the seam. A similar carriage may move a welding torch along the under side of the seam, and the freshly-made weld is rolled from both sides simultaneously to plate thickness so that the subsequent plate rolling operations will be carried out without a destructive bump being transmitted to the rolling machine.

» «

Welding Circular Sections

2,265,129. **Frederic M. Darner,** Shaker Heights, Ohio, assigned to **Republic Steel Corp.,** Cleveland, Ohio. Filed Aug. 22, 1939. Issued Dec. 9, 1941. In the continuous high speed electrical resistance welding or circular members, the steps of moving a metal strip in the direction of its length and while so moving the strip simultaneously trimming the opposite edges and then simultaneously planishing the trimmed edges to form smooth, plane, burr free edge surfaces, causing the edges to abut, and welding the edges together by the electrical resistance method.

» «

Electrode Holder

2,265,135. **Ferdinand W. Hackmeyer,** Mobile, Ala. Filed Feb. 12, 1940. Issued Dec. 9, 1941. The safety holder of this patent has expansible jaws, a hollow handle connected to one of the jaws, switch means including a cable carrier movably mounted within the handle and adapted to make and break a circuit through the holder, a second handle connected to the other jaw and means actuated by movement of the second handle for automatically operating the cable carrier to break the circuit prior to opening the jaws.

» «

Welding Gun

2,265,169. **Grover A. Hughes,** Seattle, Wash., and **John H. Brownfield,** U. S. Navy. Filed Mar. 17, 1941. Issued Dec. 9, 1941. An arc welder for welding studs is described. The stud is held by the gun and an arc between the stud and the work surface is established. Current timing is provided, the current being automatically adjusted irrespective of any irregularities on the surface or unevenness of the length of the studs.

» «